

Technical Assistance to Putnam County, Tennessee

CSI Resource Systems, Inc.
Boston, MA

Prepared for

Environmental Protection Agency
Atlanta, GA

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Solid Waste



A TECHNICAL ASSISTANCE PROGRAM REPORT

TECHNICAL ASSISTANCE TO PUTNAM COUNTY, TENNESSEE

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Technical assistance by personnel teams. 42 USC 6913

RESOURCE RECOVERY AND CONSERVATION PANELS

SEC. 2003. The Administrator shall provide teams of personnel, including Federal, State, and local employees or contractors (hereinafter referred to as "Resource Conservation and Recovery Panels") to provide States and local governments upon request with technical assistance on solid waste management, resource recovery, and resource conservation. Such teams shall include technical, marketing, financial, and institutional specialists, and the services of such teams shall be provided without charge to States or local governments.

This report has been reviewed by the Project Officer, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Project Officer: Elmer G. Cleveland

U.S. ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ASSISTANCE PROGRAM REPORT SERIES
SOLID WASTE MANAGEMENT
TECHNICAL ASSISTANCE TO
PUTNAM COUNTY, TENNESSEE

PREPARED FOR:
OFFICE OF SOLID WASTE MANAGEMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV, ATLANTA, GEORGIA

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BOSTON, MASSACHUSETTS

DECEMBER, 1980

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

Putnam County is centrally located in Tennessee, about 80 miles east of Nashville and 90 miles west of Knoxville. The County encompasses 408 square miles and is predominantly rural. The four County municipalities are Cookeville, the county seat, Algood, Baxter and Monterey. Putnam County's population was 35,487 in 1970, and is estimated to be 43,700 in 1980.

As a result of a request for technical assistance a Phase I (Project Definition and Scoping) site visit to Putnam County was authorized by EPA. The Phase I site visit was made on January 16, 1980 and a meeting was held to identify the major solid waste management concerns of Putnam County. During the Phase I meeting, the County requested technical assistance in the following areas:

- o Review landfill records and compare recorded quantities with those of similar communities.
- o Assess the present collection system for unincorporated areas of the County and evaluate alternative collection practices which may benefit the County.
- o Project the expected life of the existing landfill and estimate the volume of waste previously disposed.
- o Evaluate criteria for locating a new landfill site from a technical standpoint with regard to Federal and State regulations and guidelines.
- o Provide a preliminary assessment of materials and energy recovery markets using data collected and developed by the State of Tennessee.

Based on the results of the Phase I project definition and scoping, a Phase II (Project Implementation) Technical Assistance project was approved. The Phase II project was initiated on May 22, 1980 and was conducted during the months of May, June, July, and August, 1980. The objectives of this study were to evaluate present collection methods, review collection system alternatives, estimate remaining existing landfill capacity, examine new landfill development considerations, review landfill records and compare waste quantities with those of other similar communities and provide a preliminary assessment of materials-energy recovery.

The information generated during this study and presented in this report forms the basis for the following conclusions:

1. Putnam County generates an estimated 79 tons of solid waste per day (79 TPD₇*), based on preliminary evaluation of landfill records and conversations with County solid waste personnel; because this estimate is based largely on subjective factors and not based on a weighing program it is subject to variability and it should be viewed as an "order-of-magnitude" estimate only.
2. On a per-capita basis this estimate corresponds to a solid waste generation rate of approximately 3.6 lbs/day; per-capita waste generation for several other rural communities of similar size which were evaluated indicated per capita generation rates ranging from 6.96 to 7.13 lbs/day.
3. Instituting a weighing program at the existing landfill will assist the County in accurately determining the quantity, composition, and sources of solid waste.
4. The remaining life of the existing County landfill, assuming present waste generation rates continue, is less than two years if operations are limited to the present construction area.

* TPD₇ indicates average waste quantity in tons per day, based on 7 days per week.

5. Solid waste collection in unincorporated areas is currently performed by approximately 20 private collectors, most of whom operate with one or two trucks varying in size from 1/2 ton to 1-1/2 tons.
6. Evaluation of County landfill records for the period of September 5 - 11, 1979 indicate that:
 - the four incorporated municipalities and Tennessee Technological University (Tennessee Tech) generate approximately 53 percent of the County's solid wastes.
 - private haulers, commercial establishments, and individuals account for 22, 20, and 5 percent, respectively, of the County's solid waste production.
 - the largest private collector (two trucks) accounted for 6% of the total waste and 25% of the privately collected portion; the largest four private collectors accounted for 13% of the total waste and 60% of the privately collected portion.
7. Of the estimated 79 TPD of solid waste generated within the County, approximately 9.5 tons or 12% of the total is illegally disposed of by indiscriminate roadside dumping; another 5.5 tons or 7% is assumed to be burned or disposed of by individuals on their own private property (on-premises disposal).
8. In one Tennessee community the strategic placement of containers in rural areas was found to reduce the growth rate of illegal roadside dumps.
9. Several solid waste collection alternatives for the unincorporated areas of Putnam County were evaluated in terms of both cost and quality of service. Two systems which appear to have potential include a cannister-type collection option and a "mailbox"-type service.
 - Based on analysis of capital cost data from a number of rural communities a canister type system installed in Putnam County could have a potential initial capital cost of \$390,000 or a per-capita cost of \$22.
 - Another rural community recently received a bid for mailboxtype collection service of \$11.16 per household per month.

10. From the information available, it appears that the seven areas selected by Putnam County as potential disposal sites all are suitable for landfill development. More detailed information including specific site geology and hydrogeology, land use, transportation, etc. is necessary before a final site selection can be made by the County.
11. The County may also find suitable landfill sites in locations other than the seven selected areas based on County-wide surveys performed by the TVA and the Soil Conservation Service (SCS).
12. Provisions of State and Federal regulations and guidelines must be used for guidance in the location and development of a new landfill site.
13. Numerous potential markets for various materials, typically contained in the solid wastestream, have been identified; several of these may be located within economic transport distance. Based on this preliminary information, the potential for a limited materials recovery operation appears to exist. Materials which offer the most promise for cost-effective recovery include corrugated paper, newsprint and white goods (i.e., refrigerators, stoves, other appliances).
14. Two potential customers for resource-recovered energy have been identified. Preliminary information indicates that both have energy practices compatible with the concept of resource recovery. Additional study is necessary to determine if resource recovery is a technically and economically viable solid waste option for the County.
15. Prior to initiation of any detailed resource recovery studies it is mandatory that accurate information on the tonnage and composition of waste materials be developed. The capital investment and probability of success of resource recovery is directly linked to the quantity and quality of waste generated.

CHAPTER 2

EXISTING COLLECTION SYSTEMS

CHAPTER 2

EXISTING COLLECTION SYSTEMS

In order to effectively evaluate solid waste collection options it was first necessary to assess the quantity of waste to be disposed of in Putnam County, and then the current collection programs were analyzed. Information relative to solid waste production and collection within the County was obtained from various sources including a telephone survey conducted by Engineering-Science and a review of County landfill records.

Putnam County owns and is currently operating one landfill located about four miles south of Baxter, Tennessee through the services of a contractor, Earl Mills. Mills' company is responsible for logging in collection vehicles and estimating solid waste quantities as well as providing and operating the equipment required for land fill construction activities, general landfill maintenance and the service required for operation of a county owned front loader/packer vehicle. The collection vehicle use is limited to emptying collection boxes located at the entrance of the landfill site.

Table 2.1 summarizes the waste quantities by hauler, as logged at the landfill during a four-week period between May 1, 1980 and May 28, 1980. Municipal collection and Tennessee Tech account for 52.2%, private haulers 22.4%, businesses and commercial 20.3%, and private individuals 5.1% of the landfilled solid waste.

For the purposes of computing these percentages and volumes, it was assumed that a 3:1 compaction ratio was achieved by packer vehicles. For instance, if a 1-cu yd compacted load was logged in, the equivalent non-compacted volume was assumed to be 3 cu yd. Of course the density of compacted waste in a packer vehicle varies depending on manufacturer, percent of full load and type of vehicle (front loader versus

TABLE 2.1
PUTNAM COUNTY
SUMMARY OF LANDFILLED SOLID WASTE, BY HAULER

Week:	1		2		3		4		Total	
	May 1 - May 7, 1980	Quantity (YD ³)	May 8 - May 14, 1980	Quantity (YD ³)	May 15 - May 21, 1980	Quantity (YD ³)	May 22 - May 28, 1980	Quantity (YD ³)	May 1 - May 28, 1980	Quantity (YD ³)
Period:										
Solid Waste Hauler										
Business & Commercial	1,242	20	1,214	19	953	17	1,402	25	4,811	20.3
Cities & Tenn. Tech	3,409	54	3,226	50	2,929	54	2,834	51	12,398	52.2
Individuals	368	6	354	5	283	5	213	4	1,218	5.1
Private Haulers	1,248	20	1,661	26	1,306	24	1,100	20	5,315	22.4
Total	6,267	100	6,455	100	5,471	100	5,549	100	23,742	100.0

rear loader). The estimates of weights are based on the assumption that the non-compacted solid waste has a bulk density of 150 pounds per cubic yard and that compacted load densities average 450 pounds per cubic yard. These numbers indicate an average landfilled waste quantity of 63.6 tons per day based on a seven-day week.

In communities such as Putnam County, where much of the area is rural and no county-wide collection program exists, significant quantities of waste are disposed of by means other than the landfill. Two other disposal options are:

- on-premises disposal
- illegal, indiscriminate roadside dumping

One County official has estimated that on-premises disposal may account for 5 to 10 percent of the total county solid waste and that indiscriminate roadside dumping may account for another 10 to 15 percent of the total County solid waste. Table 2.2 presents waste quantities for the three disposal methods discussed and totals for the County, based on these estimates.

These estimates indicate total solid waste for Putnam County to be approximately 78 tons/day (unless otherwise indicated, all TPD estimates in this report will be on a seven-day per week basis). The Putnam County population has been estimated to be 43,700 persons in 1980. This yields a solid waste production rate of 3.6 lbs/capita/day. Resource recovery and recycling are not currently practiced in Putnam County, consequently, the potential impact of these are not reflected in the above estimates.

The records of solid waste quantities received at the landfill are based largely on visual observation and judgement of the person responsible for logging in the collection vehicles at the landfill. For this reason the recorded quantities have been compared with those from similar rural communities of comparable population which have instituted weighing programs, and with projected national averages for 1980. Table 2.3 presents information obtained during these weighing programs and national average figures.

Table 2.2
SUMMARY OF SOLID WASTE DISPOSAL

<u>Disposal Method</u>	<u>Relative Percentage</u>	<u>Estimated Non-Compacted Volume C.Y./DAY₇</u>	<u>Estimated Tonnages/DAY₇</u>
Landfill	81	848	63.6
On-premise disposal	7 ^a	73	5.5
Indiscriminate roadside dumping	<u>12^a</u>	<u>126</u>	<u>9.5</u>
Total County Waste	100	1,047	78.6

a Average of estimated range

TABLE 2.3
RESULTS OF WEIGHING PROGRAMS FOR SIMILAR COMMUNITIES

<u>Community</u>	<u>Population</u>	<u>Year</u>	<u>Average Tons per day (TPD)</u>	<u>Pounds per^a capita per day (pcd)</u>
Rome/Floyd County, Ga.	78,977 ^b	1978	275	6.96
LaGrange, Ga.	44,600	1979	156	7.01 ^c
Lexington County, South Carolina	127,000	1980	453	7.13
Kent/Sussex Counties, Delaware	194,325	1979	689	7.09
Four Community Average	111,226	-	392	7.05
National Values	222,345,000	1980	761,017	6.85

a Total solid waste, both processible and non-processible

b 1978 population from census estimates

c Based on combined average of 5 landfills

The average waste production rate for the four communities was 7.05 lbs/capita-day. The production rates were all very close with a range from a minimum of 6.96 to a maximum of 7.13. These rates also compare closely with a national average rate of 6.35 lbs/capita/day as calculated from a recent EPA study.

Waste production rates vary from one community to another and vary with time as consumer buying habits, commercial packaging methods, governmental regulation, and recycling or recovery markets change. While based on the results of four weighing programs the 7.05 lbs/day rate may seem to be justified for use as an average production figure, many factors are involved in waste production for a community. The range of reasonable production rates typically varies from 3 to 9 lbs/capita/day. The factors of industrial density and demolition (or development/redevelopment) play heavily upon the production rate. For instance, if the waste quantities associated with these two factors alone were removed from the national average rate of 6.85 lbs/day the resulting per capita national average waste production rate would be about 4 lbs/day. The waste production rate estimated to be 3.6 lbs/capita/day for the County should be taken as an order of magnitude estimate and should be verified by an actual weighing program prior to initiating collection, disposal or energy/materials recovery commitments. The waste production rate of 3.6 lbs/capita/day taken from the evaluation of land-fill records will be used in later chapters of this report to evaluate collection alternatives and materials recovery options. Prior to major capital investments this production rate should be verified by a weighing program.

Municipal solid waste collection is performed by the cities of Cookeville, Baxter, Algood, and Monterey. Because these cities already have solid waste collection programs the scope of this report will focus on the collection system alternatives for the unincorporated areas of the County.

Solid waste collection in the unincorporated areas is currently performed by approximately 20 private collectors. For this study, Putnam County has provided a list of these collectors and the respective

routes which they service. A recent County ordinance will require licensing of private collectors and will allow the County to gather additional information and better define the existing collection system. Areas in which one or more collectors provide service are indicated on Figure 2.1.

In order to gain information on the existing private collection system a survey was made of collectors. An attempt was made to contact all of the haulers on the County list, however, for various reasons some could not be reached. Table 2.4 summarizes the responses of collectors interviewed between August 14, 1980 and August 20, 1980. Table 2.5 summarizes the estimated waste quantities recorded at the landfill between September 5, 1979 and September 11, 1979 for each of the 20 operators on the county list.

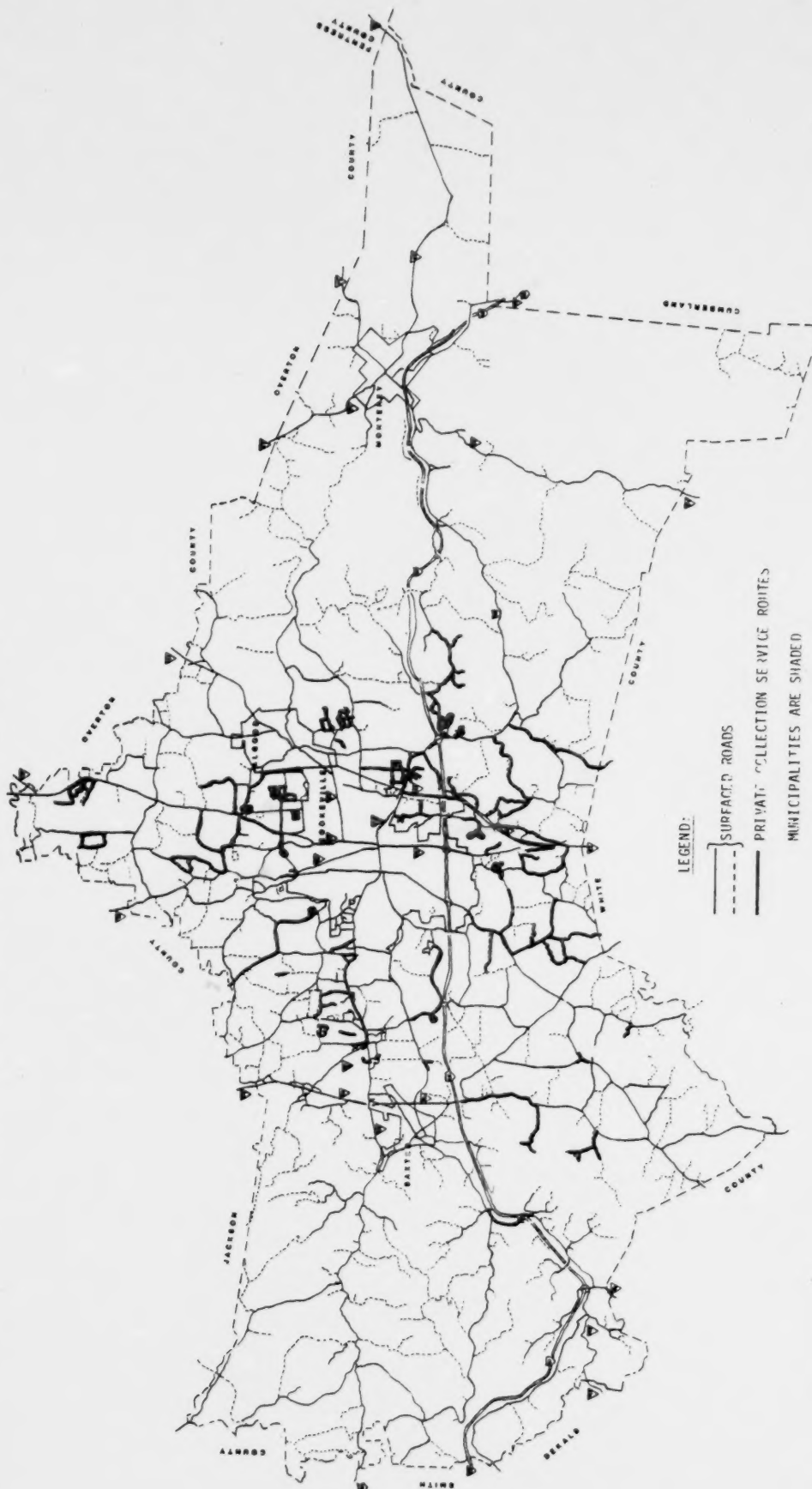
From the interviews, it is evident that most collectors operate with one or two trucks varying in size from 1/2 ton to 1-1/2 tons. Most collect both residential and business/commercial accounts. Most will pick up brush and leaves. Special pickups may be arranged through most collectors, however, it was found that the majority of collectors could not be reached by telephone during normal working hours. The largest collector based on quantity logged at the landfill over the recording period was a company owned and operated by one man. This person operates a half-day shift, Monday through Saturday.

The number of employees per company varies from one to four. Most indicated that they collected Monday through Friday. Residential collection is available on a once per week schedule. Points of collection (back door vs. street or mailbox) varied in most instances, however, three indicated back door service. One of the three collectors offering back door service also provides the least expensive service of all those surveyed.

Residential collection rates averaged about \$5.50 per month. Commercial rates varied widely depending on collection frequency and collection quantities. The minimum and maximum stated commercial rates were from \$15 per month to \$150 per month.

From Table 2.5 it can be seen that during the week of September 5, 1979 to September 11, 1979, four haulers collected a combined total of

PRIVATE COLLECTION ROUTES IN PUTNAM COUNTY



NOTE.

INFORMATION PROVIDED BY PUTNAM COUNTY

TABLE 2.4

SURVEY OF PRIVATE COLLECTORS
IN PUTNAM COUNTY, TENNESSEE

Private Collector	Equipment Used	Size of Equipment	Approximate No. of Customers	Total Number Persons Collecting	Total Number Persons in Business	Frequency of Collections	Days of Operation	Collection Rates	Pick Up Point For Collection
A	2 Trucks	-	Commercial-5	1	1	1/day	Mon-Sat	-	Collection box
B	2 Trucks	1 ton each	Residential-50 Commercial-50	3	3	Residential-1/Week Commercial-2/Week	Mon., Tues., Thurs. Sometimes Wed. & Fri.	Residential - 6.00/Month Commercial - 25.00-35.00 Mo.	Varies
C	1 Truck	3/4 Ton	Unknown same Res. & Comm.	1	2	Residential - 1/Week Commercial - 2/Week	Mon.-Fri.	Residential - 4.00, 5.00 & 6.00/Mo.	In Back of Residence or Business
D	1 Truck	1 1/2 Tons	Unknown	2	2	1/Week	Mon.-Thur.	6.00/Month	Varies
E	1 Truck	1 Ton	Residential - 105 Commercial - 12	1	1	Residential 1/Week Commercial 2/Week	Mon.-Fri.	Residential - 6.00/mo. A few 5.00 & 5.50/mo. Commercial - 1/wk 15-20/mo. 2/week-30.00/mo.	In Back of Residence or Business
F	1 Pick-up Truck	1/2 Ton	75-100	2	2	Residential 1/Week Commercial Everyday	Mon.-Fri. Some of Sat.	Depends on Amount To be Collected	Varies
G	1 Pick-up Truck	1/2 Ton	Residential - 3/4 of a Load Commercial - 1-2 Loads	1	2	Residential - 1/Week Commercial 2-3/Week	primarily Fri.	Residential - 6.00/month Commercial - 20.00-45.00/mo.	Varies
H	2 Trucks	1- 3/4 Ton 1- 1 Ton	Commercial - 7-10	1	1	Commercial - 1/Week	Mon.-Fri.	Commercial - 40.00-75.00/mo. Some 12.00/mo.	Varies Sometimes on Inside
I	2 Pick-up Trucks	1/2 Ton Each	Residential - 18 Commercial - 17	4	4	Residential - 1/Week Commercial 1 1/2/NK, Everyday	Sun.-Sat. 2-3 hrs. on Sat. & Sun.	Residential - 1/week-5.00 & 6.00 mo. Commercial - 15.00-150.00/mo.	Residential - Side and Back of Residence Commercial - Back of Business

TABLE 2.5
Estimated Tons of Solid Waste
Brought to Putnam County Landfill by Private Collectors

Private Collector	9/5/79 WED.	9/6/79 THURS.	9/7/79 FRI.	9/8/79 SAT. 1/2 day	9/9/79 MON.	9/11/79 TUES.	Total Tons of Solid Waste 9/5/79-9/11/79	% of Market
A	8.1	5.7	7.6	1.5	4.0	6.0	32.9	24.7
B	2.4	4.8		2.4		7.65	17.25	13.0
C	1.3	2.55	2.55	2.55	2.55	2.55	14.05	10.6
D	2.4	2.4	2.4		2.55	2.55	12.3	9.3
E	2.55	2.55	2.55				7.65	5.8
F	1.35		1.35	1.35	1.3	1.4	6.75	5.1
G	1.7		1.7			2.55	5.95	4.5
H		1.87				2.8	4.67	3.5
I			1.35			2.0	3.35	2.5
J2	2.0	2.0	2.0		2.0		8.0	6.0
K2	3.3			2.55			6.35	4.8
L2		1.4	1.4	1.4	1.35		5.6	4.2
M2				1.4	1.4	1.4	4.2	3.2
N2	1.3	1.5					2.8	2.1
O			1.2				1.2	0.9
P1,2							0	0
Q1,2							0	0
Q1,2							0	0
S1,2							0	0
T1,2							0	0
Total	26.9	24.8	24.1	13.2	15.2	28.9	133.0	100

1 No waste recorded for the period 9/5/79 to 9/11/79

2 Could not be contacted for participation in the survey (Table 4.1)

almost 60% of the private refuse collection market, with the top collector alone capturing 24.7%. It can also be seen that the hauler providing back door service and also charging the lowest rates is one of the top three collectors based on volume.

The private collectors combined logged 133.1 tons of solid waste at the landfill during the recording week. Private collectors haul approximately 22.4% of the total landfilled solid waste.

Current County collection includes a cleanup program performed under the direction of a State Health Department Environmentalist attached to the Putnam County Health Department. CETA workers and a one-ton dump truck are used to clean up existing indiscriminate roadside dumping sites. If the assumption is made that the dump truck is operated five days per week and can make four trips per day with a full one-ton load, this present cleanup program operates at a clean-up rate of 2.9 tons per day, based on a seven-day week. Estimates of 9.5 tons per day of waste disposal by illegal dumping have been made by a Putnam County representative. The net difference between these two figures indicates that 6.6 tons of waste per day, more than can be cleaned up, may be illegally dumped by roadsides. It should be noted that this estimate is not based on actual measurement.

In addition to the cleanup program Putnam County also owns a Dumpmaster 38-cubic yard front loader packer mounted on a Mack chassis and ten six-cubic yard canisters. The canisters are placed at the entrance to the landfill. The landfill operator empties the containers once per day using the County packer vehicle. With the containers at the landfill entrance it is not necessary for persons with small loads to enter the actual landfill, thus reducing traffic in the tipping area. The containers also provide a drop-off point for use during periods when the landfill is closed.

CHAPTER 3

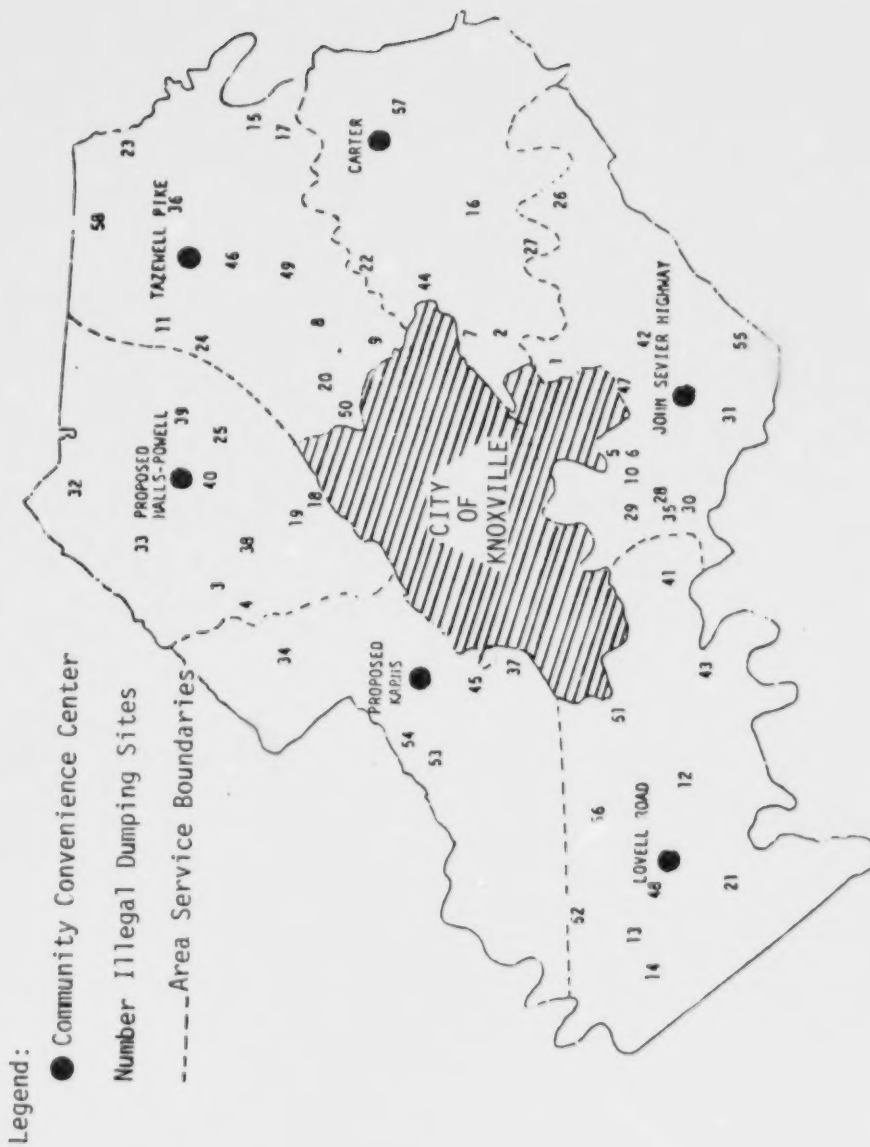
COLLECTION ALTERNATIVES

CHAPTER 3 COLLECTION ALTERNATIVES

A county wide solid waste collection system should be established in order to effectively reduce the number and magnitude of indiscriminate illegal dump sites in the County, reduce the violations of State and County litter control laws and improve County environmental conditions. It has been demonstrated that installation of solid waste collection centers effectively reduces the growth of illegal dump sites. Figure 3.1 and 3.2 show a map of illegal dump sites in Knox County, Tennessee, and the growth rate reduction (%) of these dumps versus distance from a convenience center, respectively. From Figure 3.2 it appears that there is some correlation between distance of dump site from convenience centers and growth rate reduction. The Knox County study addresses impacts due to installation of convenience centers. For Putnam County, it is felt that the same impacts could be realized whether the collection centers were larger "convenience stations", such as those in Knox County, or smaller 6 or 8 cubic yard boxes strategically placed throughout the County. The term, bulk container, will be used in this report to identify the use of a collection container regardless of size.

A study recently performed by Tennessee Tech has identified 66 indiscriminant dump sites in Putnam County. Figure 3.3 shows the dump sites which were identified after observing approximately 41% of all roads within the County.

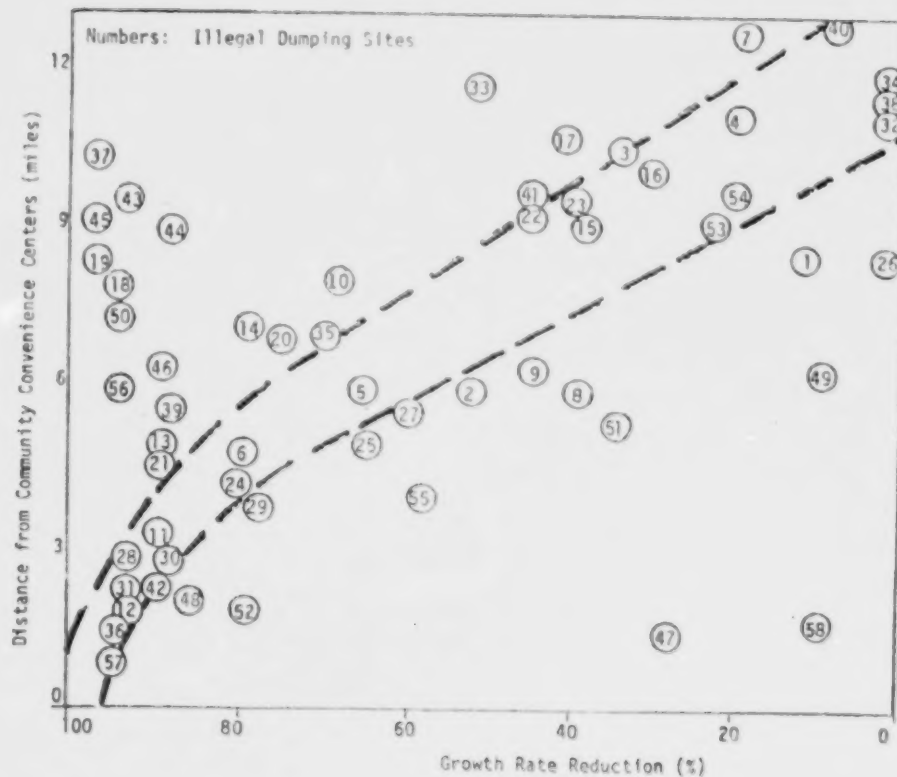
LOCATION OF COMMUNITY CONVENIENCE CENTERS & ILLEGAL DUMPING SITES



Scale 1" = 5.5 Miles

Reproduced from: Knox County Study
by Hodgson and McGhee, 1979.

GROWTH RATE REDUCTION VERSUS DISTANCE FROM COMMUNITY CONVENIENCE CENTERS



Reproduced from: Knox County Study
by Hodgson and McGhee, 1979.

There are basically four legal collection/disposal alternatives available for rural communities. They are as follows:

- on-premise disposal
- individual haul to landfill facility
- bulk container
- mailbox collection systems

The first two alternatives do not constitute an additional collection service to Putnam County residents since these options are currently available to all residents under the present system, and will remain available regardless of which collection program the County chooses to implement. Variations of the latter two alternatives should be considered in the development of a solid waste collection system for Putnam County.

Other communities similar to Putnam County have successfully implemented solid waste collection programs using a mailbox type, a bulk container type collection system or combinations of these two. Table 3.1 shows examples of rural solid waste collection equipment systems used by 22 rural communities. Table 3.2 lists the 22 counties, the capital cost per resident and the storage volume provided per resident per day for those systems employing containers. It should be noted that the costs per resident are based on the original capital investment, in the year in which the investment was made. These capital costs varied from 1968 to 1973. For purposes of escalating these costs to 1980 dollars an escalation factor was developed using Engineering News-Record indexes and assuming that the initial investments were made around 1970.

$$\text{ESCALATION FACTOR} = \frac{\text{ENR/CCI (1980)}}{\text{ENR/CCI (1970)}}$$

$$\text{ESCALATION FACTOR} = \frac{3305}{1385} = 2.39^*$$

*This is approximately equivalent to a 9% per annum inflation rate.

TABLE 3.1

EXAMPLES OF RURAL SOLID WASTE COLLECTION EQUIPMENT SYSTEMS

Location	Estimated population	Number of containers	Size of container (cu yd)	Collections per week	Number of persons per cu yd storage	Number of trucks	Size of trucks (cu yd)	Initial capital cost *
Baldwin Co., Ala.	47,000	†		1		14	16-23	\$240,000†
Chilton Co., Ala.	17,000	91	4	3	16	2	30	68,000
Choctaw Co., Ala.	14,000	†		1		3	20	48,000
Coffee Co., Ala.	14,000	170	4	1-2	14	1	30	62,700
Macon Co., Ala.	13,800	137	4	1-2	17	1	30	55,900
Madison Co., Ala.	40,000	†		1		9	23	106,000
Tuscaloosa Co., Ala.	30,000	335	5, 6	2	7	5	30	310,000
Clark Co., Ark.	11,702	142	3, 4, 6	3	6	1	30	76,058
Humboldt Co., Calif.	10,000	20	8	2	12	1	42	221,849
		2	20			1	roll-off	
		5	40					
Evans Co., Ga.	7,290	10	3	2-3	9	2	23	60,695
		70	4					
Grady Co., Ga.	10,000	126	4	2	10	1	20	49,787
Screven Co., Ga.	9,500	146	4	2	7	1	25	66,000
Benewah Co., Idaho	3,680	14	\$12	2	11	1	20	†
Bonner Co., Idaho	3,000	39	10	2	4	1	20	38,400†
Boundary Co., Idaho	2,300	17	10	2	7	1	20	17,540†
Kootenai Co., Idaho	2,250	10	\$10	2	3	1	10	50,900†
		20	\$12			1	16	
						1	20	
Shoshone Co., Idaho	1,016	11	\$4	1-2	4	1	16	†
		12	\$12				20	
DeSoto Co., Miss.	50,000	72	6	2	26	1	30	†
		78	4			1	roll-off	
		7	30			1	roll-off	
Lee Co., Miss.	17,218	97	6	2-3	17	2	30	141,200
		70	\$5			**		
Humphreys Co., Tenn.	8,796	134	6	2	4	2	31	105,465
		23	8					
Jefferson Co., Tenn.	17,014	128	4	2	14	1	30	68,310
		17	6					
Polk Co., Texas	9,500	110	4	3	5	2	30	93,086

* Data were gathered in 1974 but capital costs vary from 1968 to 1973.

† Mailbox system.

‡ Contracted.

§ Hand unload.

¶ Mobile containers.

** Three pickup trucks for towing containers.

SOURCE: Decision-Makers Guide in Solid Waste Management,
U.S. EPA, 1976.

TABLE 3.2
SYSTEM STORAGE CAPACITY VS. PER CAPITA CAPITAL COSTS

<u>Location</u>	<u>Estimated Population</u>	<u>Unadjusted Dollars/Person</u>	<u>Adjusted 1980 Dollars/Person</u>	<u>Storage Cu. Yds. Provided/Person/Day</u>
Baldwin Co., Ala.	47,000	5.11	12.21	(1)
Chilton Co., Ala.	17,000	4.00	9.56	0.009
Choctaw Co., Ala.	14,000	3.43	8.20	(1)
Coffee Co., Ala.	14,000	4.48	10.71	0.010
Macon Co., Ala.	13,800	4.05	9.68	0.008
Madison Co., Ala.	40,000	2.65	6.33	(1)
Tuscaloosa Co., Ala.	30,000	10.33	24.69	0.020
Clark Co., Ark.	11,700	6.50	15.54	0.024
Humboldt Co., Calif.	10,000	22.18	53.01	0.012
Evans Co., Ga.	7,290	8.32	19.88	0.016
Grady Co., Ga.	10,000	4.98	11.90	0.014
Scriven Co., Ga.	9,500	6.95	16.61	0.020
Benewah Co., Ga.	3,680	(2)	(2)	0.013
Bonner Co., Idaho	3,000	12.80	30.59	0.036
Boundary Co., Idaho	2,800	7.63	18.23	0.020
Kootenai Co., Idaho	2,250	22.62	54.06	0.048
Shoshone Co., Idaho	1,016	(2)	(2)	0.036
DeSoto Co., Miss.	50,000	(2)	(2)	0.005
Lee Co., Miss.	17,218	8.20	19.60	0.008
Humphreys Co., Tenn.	8,796	11.99	28.66	0.036
Jefferson Co., Tenn.	17,014	4.01	9.58	0.010
Pola Co., Texas	9,500	9.80	23.42	0.029

(1) Mailbox collection system

(2) Contracted disposal

(3) Reference Table 3.1

This factor was applied to the unadjusted capital cost per person to obtain an adjusted 1980 capital cost in dollars per person. The column cubic yards storage provided per person per day was calculated from the information in Table 3.1. The capital cost in dollars per person was plotted versus cubic yards storage provided per person and are shown in Figure 3.4. A linear regression of these data yields an equation for cost versus collection system storage for 18 green-box type systems.

Putnam County per capita waste production rates have been estimated to be approximately 3.6 lbs/capita/day. This can be converted to a volume production rate of 0.024 cubic yards/capita/day using a loose material density of 150 lbs/cubic yard. If this volume were provided the initial capital cost of a bulk container system based on the experience of other counties would be approximately \$23.00 per person. Not included in this projection are the impacts of Putnam County commercial/industrial entities hauling their own waste to the landfill. Also not reflected in this estimate are modifications which the 18 counties may have made to their collection systems since original installation, such as the installation of additional containers or collection vehicles which may have been necessary initially to provide a properly functioning collection system.

Baldwin County, Alabama has instituted a mailbox type collection program through the franchise of a private association of haulers. In this arrangement, Baldwin County established a contract (and performance bond) with a single entity responsible for providing mailbox collection service to any County household desiring the service. The contract is valid for a period of five years. During that period only collectors who are members of the association may collect solid waste; there are six members in the current association.

Each member is responsible for collection within a certain district which all members have mutually agreed upon. Should one of the collectors become delinquent, or for other reasons including equipment capabilities, not be able to service an account(s) other

PLOT OF CUBIC YARDS OF BULK CONTAINER STORAGE VS COLLECTION SYSTEM CAPITAL COST

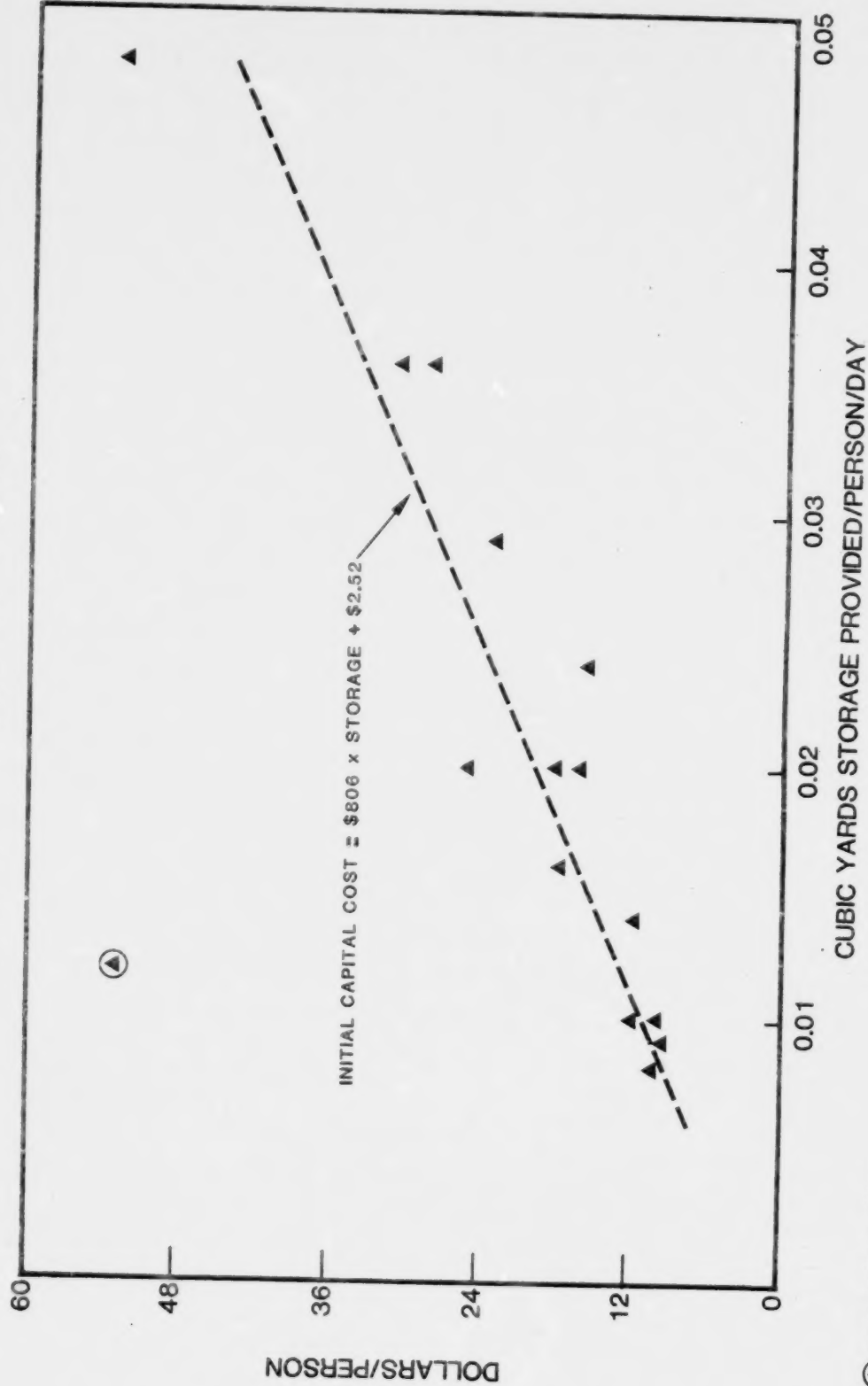


FIGURE 3.4

members of the association must provide service to those accounts. This applies also to change of service, and new accounts. If for example, an apartment complex wishes to change from back door service to containerized service, yet the association member responsible for the district in which the apartment is located does not have the equipment necessary, then another association member having the appropriate equipment may service the account.

From personal discussions with the Baldwin County Solid Waste Supervisor it was found that the six collectors operate a fleet of 25 trucks and 600 containers ranging in size from 1 to 6 cubic yards. Three of the six provide bulk container service, and one collector provides rolloff service. The association has divided the County into six districts. Each district contains a portion of the densely populated urban areas and sparsely populated rural areas. This provides a financial balance between the more lucrative accounts requiring less travel time between stops and the burden of rural accounts. The association must provide service to all residents who wish to have it, regardless of where a customer may be located.

Individual collectors may charge any price they choose up to the maximum rates established in the contract with the County. Collectors may include in their billings to customers a 30% surcharge for back door pick up if customers request this additional service. Landfill charges are paid by the collectors and are included in the collection rates which they charge customers. The following are the present maximum collection rates for Baldwin County:

Monthly Costs of Collection Service

<u>level of service</u>	<u>once/wk</u>	<u>twice/wk</u>
mailbox	\$5.25	\$ 7.00
back door	\$8.00	\$10.00

The solid waste supervisor has estimated that the largest of the six collectors services about 5,000 accounts. If all of these

accounts were provided the minimum level of service this member of the association would be billing customers for over \$300,000 per year.

These rates are based on each of the members servicing densely populated town areas as well as less densely populated rural areas. If service were limited only to the rural areas, such as the situation in Putnam County, the average rate per residence served would likely be much higher than the \$5.25 minimum for Baldwin County. Recently, Browning Ferris Industries (BFI) was low bidder for providing collection services for rural areas of another Alabama County. The per residence cost was \$11.16 per month for once per week mailbox collection.

Three important decisions which need to be made to develop an effective solid waste collection system for the unincorporated areas of Putnam County include:

1. What form of management should the system have and what role should the County play in operation of the system?
2. What level of service to the customers or County residents should be provided?
3. How will the system be funded?

The answers to these questions require a great deal of consideration, are interactive and none can be answered independently.

Many different forms of collection system management are available to Putnam County. Five have been selected for inclusion in this study. A brief description of the five management models, level of service options, and possible means of funding are provided in the following:

1. Private Business License Operation - This form of operation would be similar to the current County system except that all collectors would be required to obtain a collection license. Through the licensing process, the County could establish certain minimum

requirements which haulers would have to maintain such as watertight beds on collection vehicles and totally enclosed or screened waste compartments. It may also be possible to establish rate and service schedules, although the competitive nature of this type of free enterprise system would probably be self-controlling. With this arrangement it would be very difficult to make the service of remote areas of the County mandatory. Most collectors may not be interested in providing service to these areas since the housing densities in some parts of Putnam County are less than 1 unit per square mile.

Funding under this option would be by direct customer billing and level of service would be mailbox or backdoor.

2. Districting - In this form of management, Putnam County would be divided into a number of districts similar to the system previously discussed for Baldwin County, Alabama. One contractor would be responsible for providing service to one district. The districts could be designed so that each would share a portion of the more densely populated areas near the four cities and a portion of the more remote areas of the County. Putnam County could contractually establish rate structures. Short duration contracts of perhaps one year periods could be bid on with renewal options by prospective collectors desiring to operate within a particular district. The bids could be made on a rate structure basis or a lump sum basis depending on whether the funding was to be direct customer billing or by County property or sales taxes.

Because of the districting, Putnam County could make services available to all residents in a particular district within a fixed rate structure. In effect, residents in more densely populated areas would be subsidizing the cost of collection from the more remote areas.

In addition to the mailbox level of service, this form of management also could allow bulk container collection or a combination of bulk container and mailbox, because it would be very difficult to control the use of collection boxes. These alternatives would need to be supported by distributed funding options such as a tax subsidy.

3. County-wide Franchise - This management option is contractually the same as the Baldwin County, Alabama System in that Putnam County would administer and award a franchise to a single entity. That entity would be responsible for providing service to the entire unincorporated County. Putnam County could award a franchise based on a bid similar to the districting alternative previously discussed and prospective contractors could form associations for bidding purposes. It is possible that some larger firms from outside the County would be interested in bidding on a county-wide franchise. As in Option 2, it would be possible for Putnam County to make collection service available to all residents.

This system could include both mailbox pickup and bulk container collection, or a combination. It is possible that zones could be established based on population densities. Persons residing within certain zones could receive mailbox collection, whereas persons in very remote zones could receive bulk container service. Again, however, if bulk containers are used the funding will need to be at least partially distributed.

4. Contract Operation - This option would be similar to Option 3 except that the operation would be completely supported by Putnam County or distributed funds. The contract would be awarded on a bid basis and service would be provided for all residents of unincorporated

areas. Short term contracts may increase competition among bidders as well as reducing the costs which a prospective contractor must include in his bid to reflect various time dependent national and local economic unknowns. Longer contractual arrangements could be made with periodic economic adjustments.

5. County Operation of a Solid Waste Collection System -

This option includes complete County operation and would allow the greatest flexibility in providing service to residents. Various levels of service from mailbox to county wide container service could be provided. Modifications to the collection system operation could be made at any time Putnam County residents desire.

Under this option, it is also possible for the business license free enterprise alternative to operate. The County could provide bulk container service to all areas and private collectors could provide parallel mailbox service to those customers who desire it. Each resident would then have the option of contracting for the services of a private collector or hauling waste to a local County bulk container location himself. With this concept it could also be possible for Putnam County to designate certain larger container areas for use by the private haulers. Under the present private collection system, the survey has shown that most existing haulers operate with small non-packer type vehicles. This concept would in effect provide a number of minitransfer stations for use by either the private collectors or residents.

It is felt that because of the small size of current private collection vehicles, the waste loading impact on mini-transfer bulk container stations would not prohibit their use. Other considerations, however, may make this alternative less attractive. Structures necessary for the unloading or transfer operation would

make the location of bulk containers more permanent and would reduce the flexibility inherent in a container type system. It is possible that, considering the size of the existing private collection vehicles, temporary semi-portable transfer structures could be constructed, perhaps fabricated out of bolted structural shapes.

Any of the systems which include unmanned bulk containers will have some inherent problems. Abuse of the area, improper use of the containers, vandalism, theft, and occasional overloading all reduce the attractiveness of a containerized system. The private/county system described under Option 5 could also be operated with the bulk container service contracted out, either County-wide or by districts.

Funding options available depend largely on level of service and on the management option. Options include contractor direct customer billing, county billing, as well as distributed funding options including utility attachment of non-municipal residents, sales tax, or a tax on non-municipal property.

During the fall when brush and leaf quantities may overload a collection system a greater collection frequency may be necessary. The County could provide for special pickups of brush, leaves, and other materials in conjunction with resource recovery options discussed in Chapter 5. Certain requirements of collection customers could be implemented which would increase the efficiency and decrease the corresponding cost of special pickups, including brush and leaves. Much manpower is required to gather loose refuse by hand or pitchfork and lift it into collection vehicles. Leaves, grass clippings and other loose cuttings should be containerized by the residents (bag or can). Branches and brush which are difficult to containerize should be bound in bundles not exceeding 4 feet in length. Bundles and containers could then be collected by special pick-up, or as part of regularly scheduled collection service.

Some of the distributed funding options could be made to reflect the increased costs associated with some aspects of the collection process. For example, the sales tax might be levied selectively on bulky

or waste intensive items, on nonreturnable bottles, and cans. A property tax might apply as some function of the area of the property. With respect to the sales tax option, some campaigning against this type of selective taxation may be expected from affected entities (i.e. beverage distributors, etc.). For the property tax option, larger parcels (located in more remote parts of Putnam County) would then be allocated a larger share of the cost of collection.

Levels of service, as previously described include mailbox pick-up, bulk container pick-up and a possible combination of these two options.

The three collection system development questions presented earlier interact upon one another. Tables 3.3, 3.4 and 3.5 have been developed to illustrate this interrelationship as level of service versus collection management options, collection management options versus funding options, and level of service versus funding options. Information is presented in matrix form and shows the relationship on a scale of 1 to 3. A relation factor of 1 indicates that the two options could work together very well; a factor of 3 indicates that the combination of alternatives is impractical. The actual numbers appearing in the tables reflect average situations which may be encountered. Putnam County may choose to further refine its definition of the type of collection system which would be most suitable using the tables, and then in turn, refine the tables, until all three development questions have been satisfactorily answered.

In order to develop bulk container system configurations, an Engineering-Science computer model, SOWCOL (Solid Waste Collection), was run. Input parameters included Putnam County population densities obtained from USGS quadrangle map house counts and census bureau information. Also entered as input were per capita waste generation rates, waste densities, maximum resident travel to waste collection points and size restrictions on bulk containers. Figure 3.5 shows a grid map illustrating the population density in the County (i.e. an input into the SOWCOL model.) Figure 3.6 shows a base computer coordinate grid map. The output of SOWCOL provides theoretical coordinate locations of bulk containers. Table 3.6 shows three sets of conditions for which the model was run. The output from the model is presented in Tables 3.7-3.9.

TABLE 3.3

ALTERNATIVES FOR COLLECTION LEVEL OF RESIDENTIAL SERVICE VS.

COLLECTION MANAGEMENT OPTIONS

Solid Waste Collection Management Options	Residential Level of Service Provided		
	Mailbox Service	Mailbox Service Supplemented by Bulk Containers	Bulk Containers
Option I Private Business License Operation	1	3	3
Option II Districting	1	2	2
Option III County-wide Franchise	1	1	1
Option IV Contract	2	1	1
Option V County Operation	2	2	1

Key:

1 = most viable

2 = viable

3 = least viable

TABLE 3.4

SOLID WASTE COLLECTION MANAGEMENT OPTIONS VS. FUNDING OPTIONS

Solid Waste Collection Management Options	Funding Options			Tax Supported
	Contractor Direct Customer Billing	County Direct Customer Billing	Utility Attachment	
Option I Private Business License Operation	1	3	3	3
Option II Districting	1	2	2	2
Option III County-wide Franchise	2	2	2	2
Option IV Contract	3	2	2	2
Option V County Operation	2	2	2	2

key:

1 = most viable

2 = viable

3 = least viable

TABLE 3.5
COLLECTION LEVEL OF SERVICE VS. FUNDING OPTIONS

Level of Residential Service Provided	Funding Options				Tax Supported
	Contractor Direct Customer Billing	County Direct Customer Billing	Utility Attachment		
Mailbox	1	2	2		2
Mailbox Supplemented by Bulk Containers	2	2	2		2
Bulk Containers	3	3	2		1

Key:

1 = most viable

2 = viable

3 = least viable

PUTNAM COUNTY POPULATION DENSITIES



FIGURE 3.6

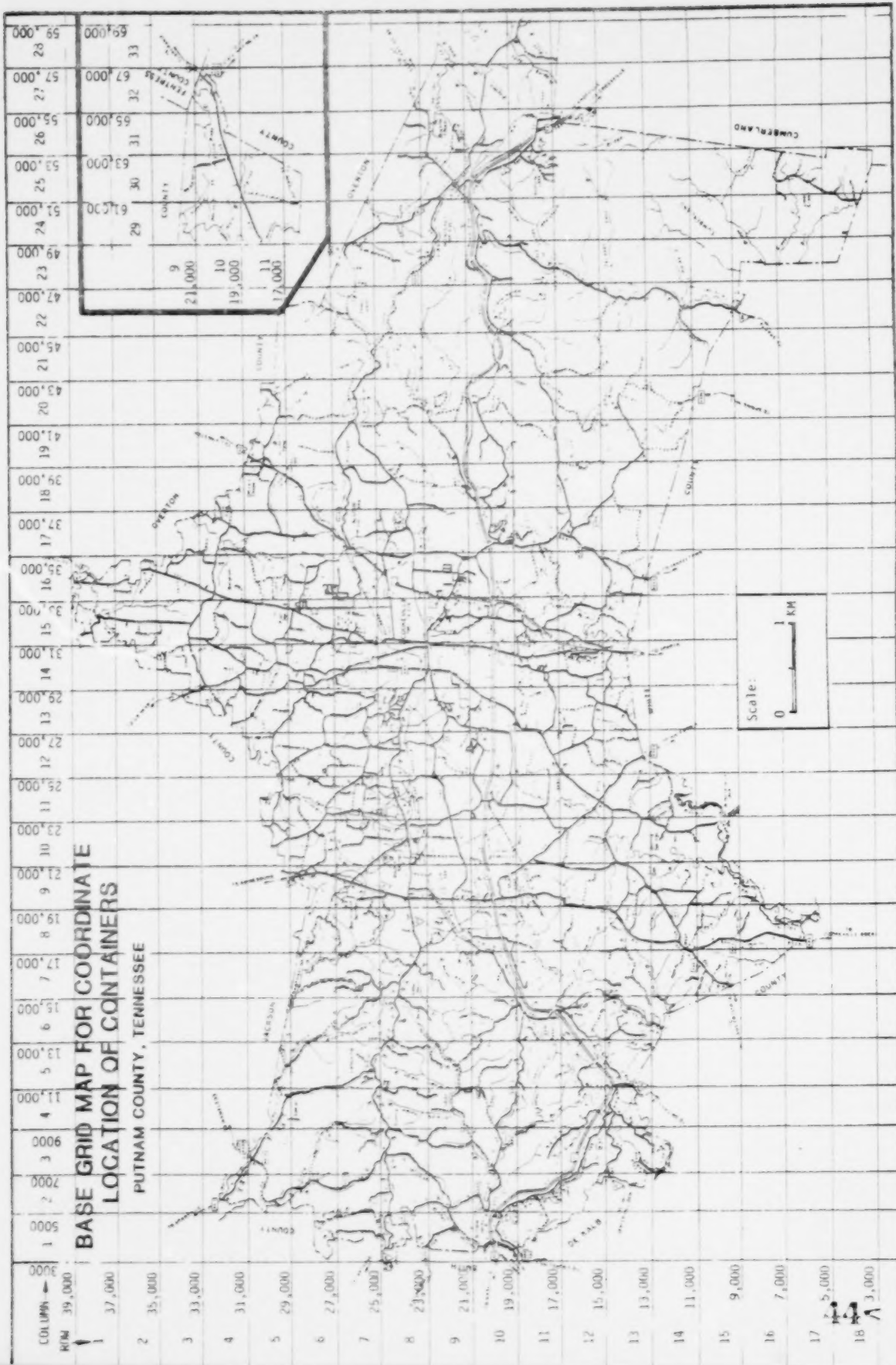


TABLE 3.6

COLLECTION CONDITIONS

	Waste Production Rate #/capita/day	lb/C.Y. Density	Container Size C.Y.	Collections Per Week	Output Table	Remarks
1.	3.6	150	8	1	3.7	Small container system (non-compacted)
2.	3.6	150	40	1	3.8	Large container system (non-compacted)
3.	3.6	600	40	5	3.9	Manned convenience center (4:1 waste compaction ratio)

TABLE 3.7

SMALL BULK CONTAINER LOCATION ALTERNATIVE
(Computer Print-out from ES Model SOWCOL)

COLLECTION CRITERIA

PERSONS PER HOUSING UNIT= 2.6
SOLID WASTE PRODUCTION (LBS/DAY/CAPITA)= 3.6
AVG. WASTE DENSITY (LBS/CF)= 5.56
CONTAINER SIZE (CY)= 8
NO. COLLECTIONS PER WEEK= 1

HOUSES POPULATION SOLID WASTE NO. LOCATION
SERVED SERVED TONS VOL UNITS (COORDINATES)
NORTH EAST

16	42	0.5	7.0	1	37904	31938	1	15	124	322	4.1	54.1	7	25977	27983	7	13
20	52	0.7	8.7	1	36015	31979	2	15	39	101	1.3	17.0	2	25986	29988	7	14
19	49	0.6	8.3	1	35975	34205	2	16	112	291	3.7	48.9	6	25974	32025	7	15
14	36	0.5	6.1	1	33917	29706	3	14	68	177	2.2	29.7	4	25965	34022	7	16
29	75	1.0	12.7	2	34014	31981	3	15	17	44	0.6	7.4	1	26066	37976	7	18
18	47	0.6	7.9	1	34000	34078	3	16	45	117	1.5	19.6	2	25988	40060	7	19
29	75	1.0	12.7	2	32007	29944	4	14	38	99	1.2	16.6	2	25924	42180	7	20
30	78	1.0	13.1	2	32000	32000	4	15	18	47	0.6	7.9	1	26345	46357	7	22
36	94	1.2	15.7	2	32026	34026	4	16	22	57	0.7	9.6	1	23690	4191	8	1
24	62	0.8	10.5	1	32152	36216	4	17	34	88	1.1	14.8	2	23876	7771	8	3
32	83	1.0	14.0	2	30146	25950	5	12	21	55	0.7	9.2	1	23924	9991	8	4
33	86	1.1	14.4	2	30047	28000	5	13	28	73	0.9	12.2	2	23945	12108	8	5
36	94	1.2	15.7	2	30029	29972	5	14	43	112	1.4	18.8	2	23958	13930	8	6
43	112	1.4	18.8	2	30000	32000	5	15	67	174	2.2	29.2	4	24047	15970	8	7
30	78	1.0	13.1	2	29986	34014	5	16	34	88	1.1	14.8	2	24073	18000	8	8
32	83	1.0	14.0	2	30056	36053	5	17	62	161	2.0	27.1	3	24027	19976	8	9
27	70	0.9	11.8	1	30090	37995	5	18	110	286	3.6	48.0	6	24000	22000	8	10
50	130	1.6	21.8	3	30251	40022	5	19	128	333	4.2	55.9	7	24000	24015	8	11
18	47	0.6	7.9	1	28688	5814	6	2	93	216	2.7	36.2	5	24015	35965	8	17
18	47	0.6	7.9	1	28790	8150	6	3	31	81	1.0	13.5	2	24017	37985	8	18
16	42	0.5	7.0	1	28897	9899	6	4	36	94	1.2	15.7	2	24020	40111	8	19
14	36	0.5	6.1	1	28122	15625	6	7	15	39	0.5	6.5	1	24606	48269	8	23
26	68	0.9	11.3	2	28349	20129	6	9	14	36	0.5	6.1	1	21545	10299	9	4
33	86	1.1	14.4	2	28132	22059	6	10	19	49	0.6	8.3	1	22000	15906	9	7
34	88	1.1	14.8	2	28393	23824	6	11	34	88	1.1	14.8	2	22000	18000	9	8
83	216	2.7	36.2	5	28016	25984	6	12	62	161	2.0	27.1	3	22000	20000	9	9
83	216	2.7	36.2	5	28000	26000	6	13	58	151	1.9	25.3	3	22000	22000	9	10
77	200	2.5	33.6	4	28000	30000	6	14	39	101	1.3	17.0	2	22032	24033	9	11
125	325	4.1	54.6	7	28000	32000	6	15	37	96	1.2	16.1	2	22058	26009	9	12
78	203	2.6	34.0	4	27991	34020	6	16	22	57	0.7	9.6	1	22039	28125	9	13
20	52	0.7	8.7	1	27967	37976	6	18	76	198	2.5	33.2	4	22016	31962	9	15
16	42	0.5	7.0	1	28333	42298	6	20	153	398	5.0	66.8	8	22016	34000	9	16
15	39	0.5	6.5	1	26148	5682	7	2	15	39	0.5	6.5	1	22103	35903	9	17
19	49	0.6	8.3	1	26065	9961	7	4	30	78	1.0	13.1	2	22000	38000	9	18
31	81	1.0	13.5	2	26564	12385	7	5	18	47	0.6	7.9	1	22140	40148	9	19
26	68	0.9	11.3	1	26172	15897	7	7	17	44	0.6	7.4	1	22422	42206	9	20
111	289	3.6	48.4	6	26012	19970	7	9	41	107	1.3	17.9	2	22103	49932	9	24
42	109	1.4	18.3	2	26000	22000	7	10	40	104	1.3	17.5	2	22359	52075	9	25
88	229	2.9	38.4	5	25986	24015	7	11	59	153	1.9	25.8	3	22161	54093	9	26
36	94	1.2	15.7	2	25941	26009	7	12	3	8	0.1	1.3	0	21675	61859	9	30
									20	52	0.7	8.7	1	19603	4182	10	1
									49	127	1.6	21.4	3	19984	5932	10	2
									20	52	0.7	8.7	1	20093	7992	10	3
									22	57	0.7	9.6	1	20253	13746	10	6
									46	120	1.5	20.1	3	20027	15973	10	7
									63	164	2.1	27.5	3	20000	18000	10	8
									29	75	1.0	12.7	2	20000	20000	10	9
									38	99	1.2	16.6	2	20000	22000	10	10
									48	125	1.6	20.9	3	20000	24000	10	11
									65	169	2.1	28.4	4	20000	26000	10	12
									22	57	0.7	9.6	1	20040	28131	10	13
									29	75	1.0	12.7	2	20031	31895	10	15
									34	88	1.1	14.8	2	20000	34000	10	16
									66	172	2.2	28.8	4	19986	36014	10	17

TABLE 3.7 (Continued)

[illegible]

TABLE 3.8

LARGE BULK CONTAINER LOCATION ALTERNATIVE
(Computer Print-out from ES Model SOWCOL)

COLLECTION CRITERIA

PERSONS PER HOUSING UNIT= 2.6

SOLID WASTE PRODUCTION (LBS/DAY/CAPITA)= 3.6

AVG. WASTE DENSITY (LBS/CF)= 5.56

CONTAINER SIZE (CY)= 40

NO. COLLECTIONS PER WEEK= 1

HOUSES SERVED	POPULATION SERVED	SOLID WASTE TONS	WASTE VOL CY	NO. UNITS	LOCATION (COORDINATES)		
					NORTH	EAST	
50	130	1.8	21.8	1	30053	39791	5 19
83	216	2.7	36.2	1	29164	26234	6 12
83	216	2.7	36.2	1	29624	28608	6 13
77	200	2.5	33.6	1	30970	31536	6 14
125	325	4.1	54.6	1	29090	32285	6 15
78	203	2.6	34.0	1	30360	34288	6 16
111	289	3.6	48.4	1	26362	20138	7 9
88	229	2.9	38.4	1	26622	23764	7 11
124	322	4.1	54.1	1	25952	27938	7 13
112	291	3.7	48.9	1	25888	32127	7 15
45	117	1.5	19.6	0	25014	40487	7 19
18	47	0.6	7.9	0	25910	46846	7 22
22	57	0.7	9.6	0	23977	4336	8 1
34	88	1.1	14.8	0	25957	7626	8 3
67	174	2.2	29.2	1	25503	13017	8 7
110	286	3.6	48.0	1	23362	21516	8 10
128	333	4.2	55.9	1	23192	24191	8 11
83	216	2.7	36.2	1	23950	36312	8 17
76	198	2.5	33.2	1	21719	32024	9 15
153	398	5.0	66.8	2	19688	36261	9 16
3	8	0.1	1.3	0	21675	61859	9 30
49	127	1.6	21.4	1	19856	6348	10 2
63	164	2.1	27.5	1	19640	18912	10 8
65	169	2.1	28.4	1	18870	25781	10 12
75	195	2.5	32.7	1	20325	48180	10 24
66	172	2.2	28.8	1	20681	52998	10 26
4	10	0.1	1.7	0	20000	66000	10 32
77	200	2.5	33.6	1	17428	13792	11 6
76	198	2.5	33.2	1	16299	30781	11 14
12	31	0.4	5.2	0	18839	58473	11 28
82	213	2.7	35.8	1	14835	9420	13 4
49	127	1.6	21.4	1	13408	19698	13 8
24	62	0.8	10.5	0	13901	41785	13 20
11	29	0.4	4.8	0	13568	46759	13 22
1	3	0.0	0.4	0	14000	54000	13 26
77	200	2.5	33.6	1	10169	18106	15 7
19	49	0.6	8.3	0	5890	51664	17 25

TABLE 3.9

CONVENIENCE CENTER LOCATION ALTERNATIVE
(Computer Print-out from ES Model SOWCOL)

COLLECTION CRITERIA
PERSONS PER HOUSING UNIT= 2.6
SOLID WASTE PRODUCTION (LBS/DAY/CAPITA)= 3.6
AVG. WASTE DENSITY (LBS/CF)= 22.24
CONTAINER SIZE (CY)= 40
NO. COLLECTIONS PER WEEK= 5

HOUSES SERVED	POPULATION SERVED	SOLID WASTE TONS	WASTE VOL CY	NO. UNITS	LOCATION (COORDINATES)		
					NORTH	EAST	
50	130	0.3	1.1	0	30053	39791	5 19
125	325	0.8	2.7	0	29233	32990	6 15
111	289	0.7	2.4	0	25539	20838	7 9
124	322	0.8	2.7	0	28815	28689	7 13
45	117	0.3	1.0	0	25014	40487	7 19
18	47	0.1	0.4	0	25910	46846	7 22
22	57	0.1	0.5	0	23977	4336	8 1
34	88	0.2	0.7	0	25957	7626	8 3
67	174	0.4	1.5	0	25503	13017	8 7
128	333	0.8	2.8	0	24652	23857	8 11
153	398	1.0	3.3	0	20810	35690	9 16
3	8	0.0	0.1	0	21675	61859	9 30
49	127	0.3	1.1	0	19856	6348	10 2
63	164	0.4	1.4	0	19640	18912	10 8
65	169	0.4	1.4	0	18870	25781	10 12
75	195	0.5	1.6	0	20325	48180	10 24
66	172	0.4	1.4	0	20681	52998	10 26
4	10	0.0	0.1	0	20000	66000	10 32
77	200	0.5	1.7	0	17428	13792	11 6
76	198	0.5	1.7	0	16299	30781	11 14
12	31	0.1	0.3	0	18839	58473	11 28
82	213	0.5	1.8	0	14835	9420	13 4
49	127	0.3	1.1	0	13408	19698	13 6
24	62	0.2	0.5	0	13901	41785	13 20
11	29	0.1	0.2	0	13568	46759	13 22
1	3	0.0	0.0	0	14000	54000	13 26
77	200	0.5	1.7	0	10169	18106	15 7
19	49	0.1	0.4	0	5890	51664	17 25

The coordinates shown in these tables have been plotted on Figures 3.7, 3.8, and 3.9 respectively. These theoretical coordinates were then manually adjusted to coincide with transportation routes as shown on the respective figures to illustrate possible logical container or convenience center locations.

In the actual implementation of bulk container collection system consideration should be given to locating remote area containers in or near a small residential or business community. In some Tennessee counties similar to Putnam which have implemented container systems it has been found that containers not in plain sight have been subject to abuse and vandalism.

The quantity and locations of containers in the three "level of service" options shown in Figures 3.7-3.9 have been based on a number of assumptions including waste density and waste generation rates derived from landfill operation records. These assumptions should be verified by a weighing program prior to final design and implementation of a collection system.

FIGURE 3.7

SMALL CONTAINER COLLECTION OPTION

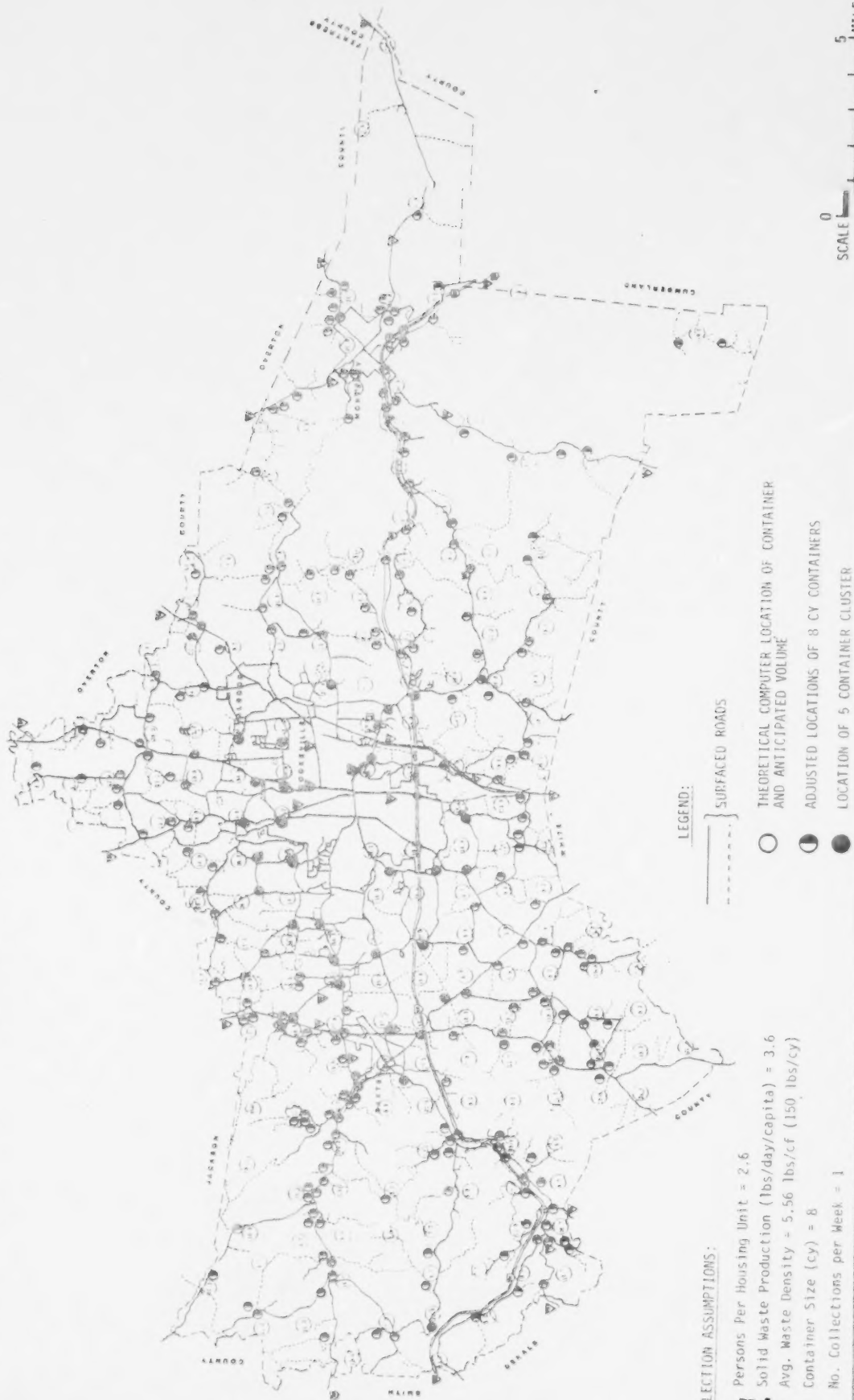


FIGURE 3.8

LARGE CONTAINER COLLECTION OPTION

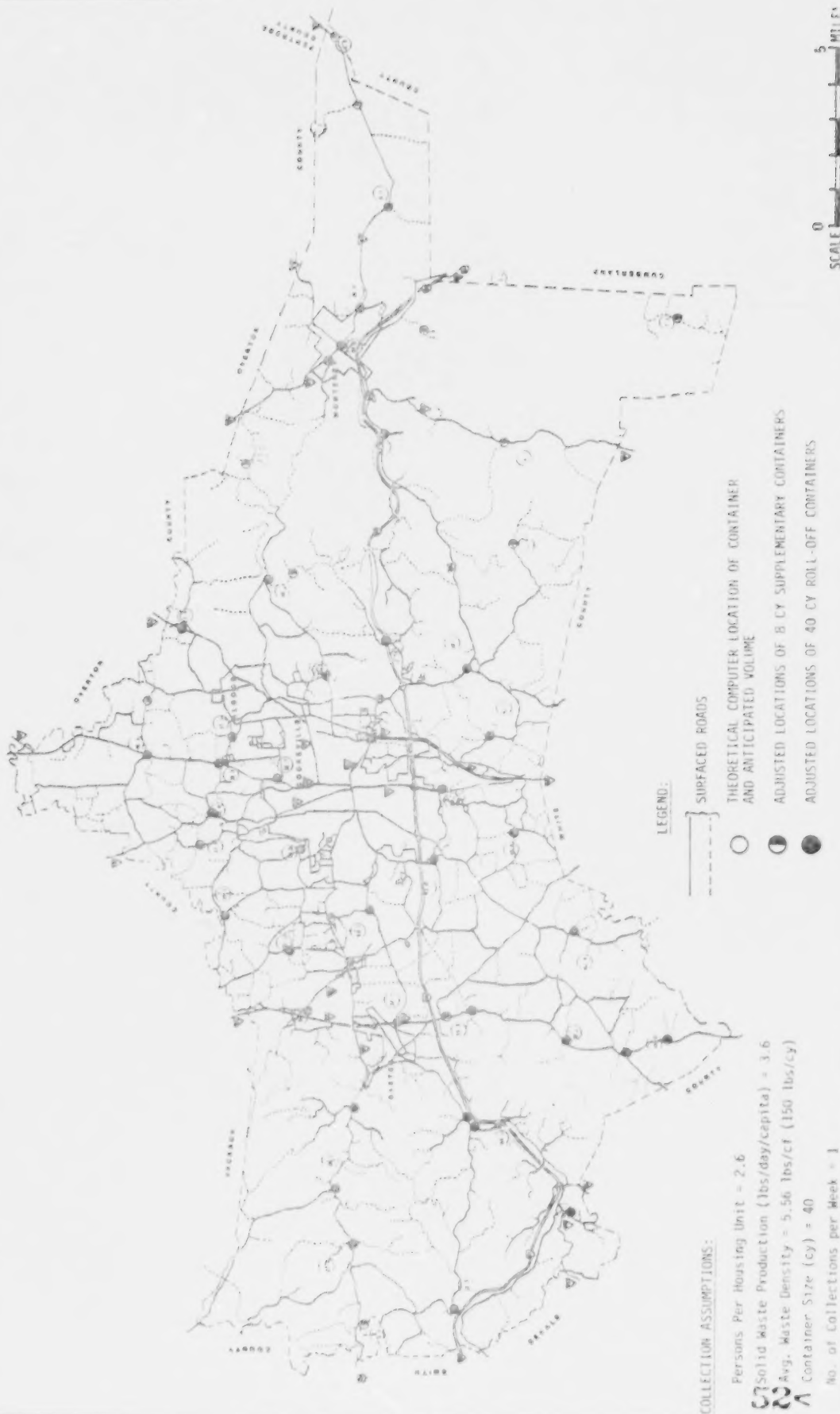
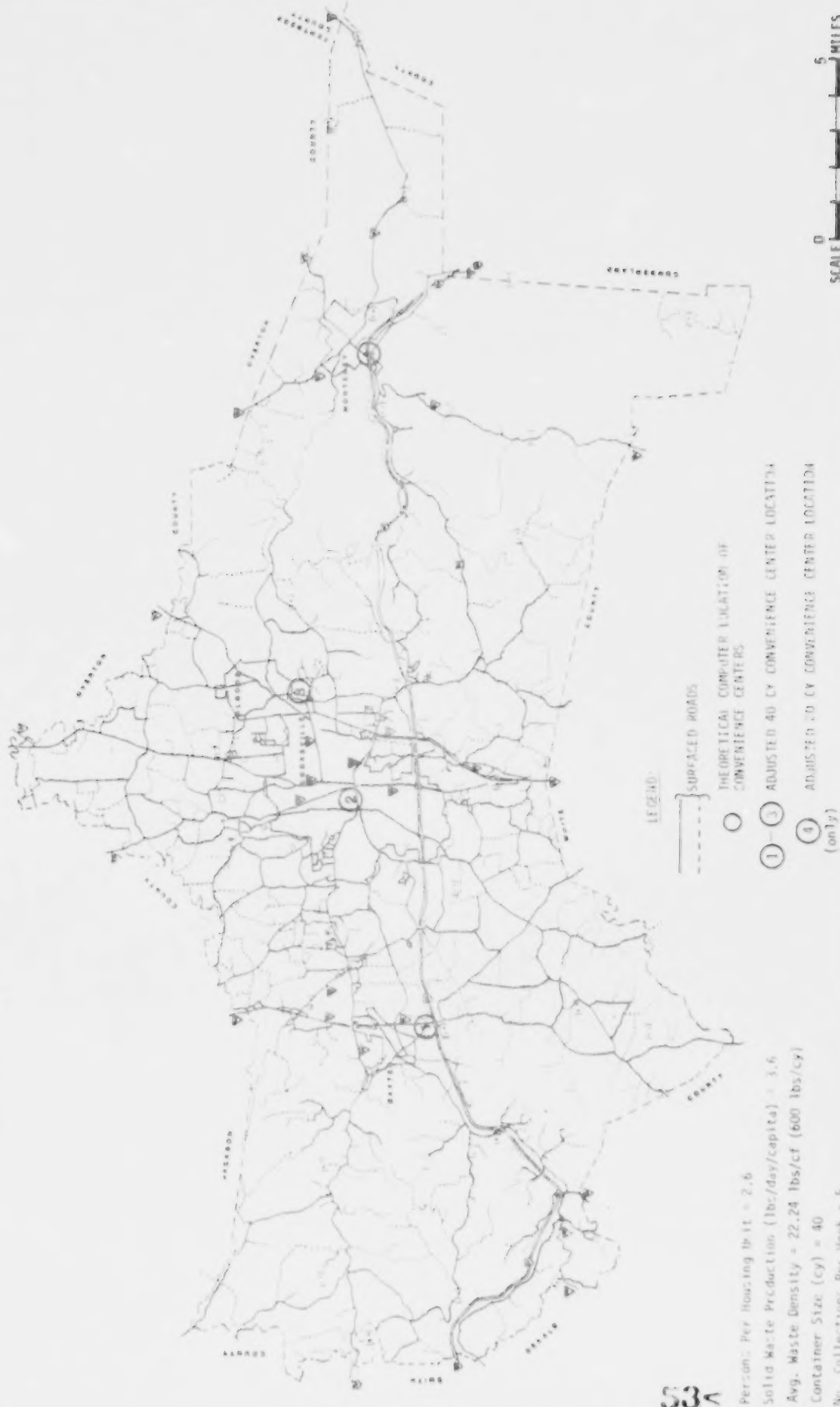


FIGURE 3.5

CONVENIENCE CENTER COLLECTION OPTION



CHAPTER 4

PRELIMINARY ASSESSMENT OF PRESENT AND FUTURE
LANDFILL SITES

CHAPTER 4
PRELIMINARY ASSESSMENT OF PRESENT AND FUTURE
LANDFILL SITES

The present County landfill site is located approximately three miles south and one-half mile west of the town of Baxter, Tennessee. The 150-acre parcel on which the landfill is located is approximately 2,500 feet wide, from north to south, and 3,500 feet from east to west. The site is on a ridge line which drains to the north to Mine Lick Creek, and to the south to Mine Lick Creek and Tom Hollow Creek. Tom Hollow Creek joins Mine Lick Creek and flows on to Center Hill Lake. Center Hill Lake is impounded by a dam and is used for power generation, flood control and recreation.

The landfill was opened by Putnam County in 1974. From 1974 to 1978 the landfill was operated for the County under contract by private companies, during which time much of the usable portion of the land was consumed by operations. Of the 150-acre parcel, 30 to 40 acres were acceptable to the State Health Department for land-filling purposes. In 1979 it was estimated that 4 to 5 acres of suitable land remained at the site. With guidance from State Health Department officials, landfill construction methods were developed which have significantly reduced the rate of land usage.

From Chapter 2 it has been estimated that per capita waste production in Putnam County is approximately 3.6 lbs/day. The average of the population between 1974 and 1980 is taken to be the population in 1977. Census bureau figures indicate this count to be 41,500. If this figure is applied to the waste production rate the estimated waste quantity in the landfill would be:

$$T = 365 \text{ days} \times (1980-1974) \text{ years} \times 3.6 \text{ lbs} \quad 2000 \text{ lbs/ton} \\ \times 41,500 \text{ persons} = 164,000 \text{ tons}$$

Using an in-place waste density of 900 lbs/yd³ the in-place volume would then be:

$$V = 164,000 \text{ tons} \times 2000 \\ = 364,000 \text{ yd}^3$$

Figure 4.1 shows the location and approximate boundaries of the existing landfill site. The present landfill method has been developed by the State Health Department in conjunction with the Upper Cumberland Development District (UCDD).

Figure 4.2 uses the UCDD plan as a base, and illustrates the approximate area landfilled as of July, 1980. Figure 4.3 illustrates the area method of landfilling employed, and Figure 4.4 shows typical cross sections through the landfill and a section through one of the dikes.

If the present methods of operation are continued based largely on the recent land consumption rate, it is estimated that the present site will be exhausted within two years. From Figure 4.5, using the per capita waste generation rate of 3.6 lb/day, it can be calculated that Putnam County would use 1.8 acres per year of landfill area. From Figure 4.2 about 3 acres of usable land remain.

NEW LANDFILL LOCATION ALTERNATIVES

The County has identified seven general areas in which development of a new landfill site is being considered. These seven areas are shown on Figure 4.6. Also shown on Figure 4.6 is the approximate centroid of population of Putnam County and the location of the existing landfill.

PUTNAM COUNTY EXISTING LANDFILL SITE

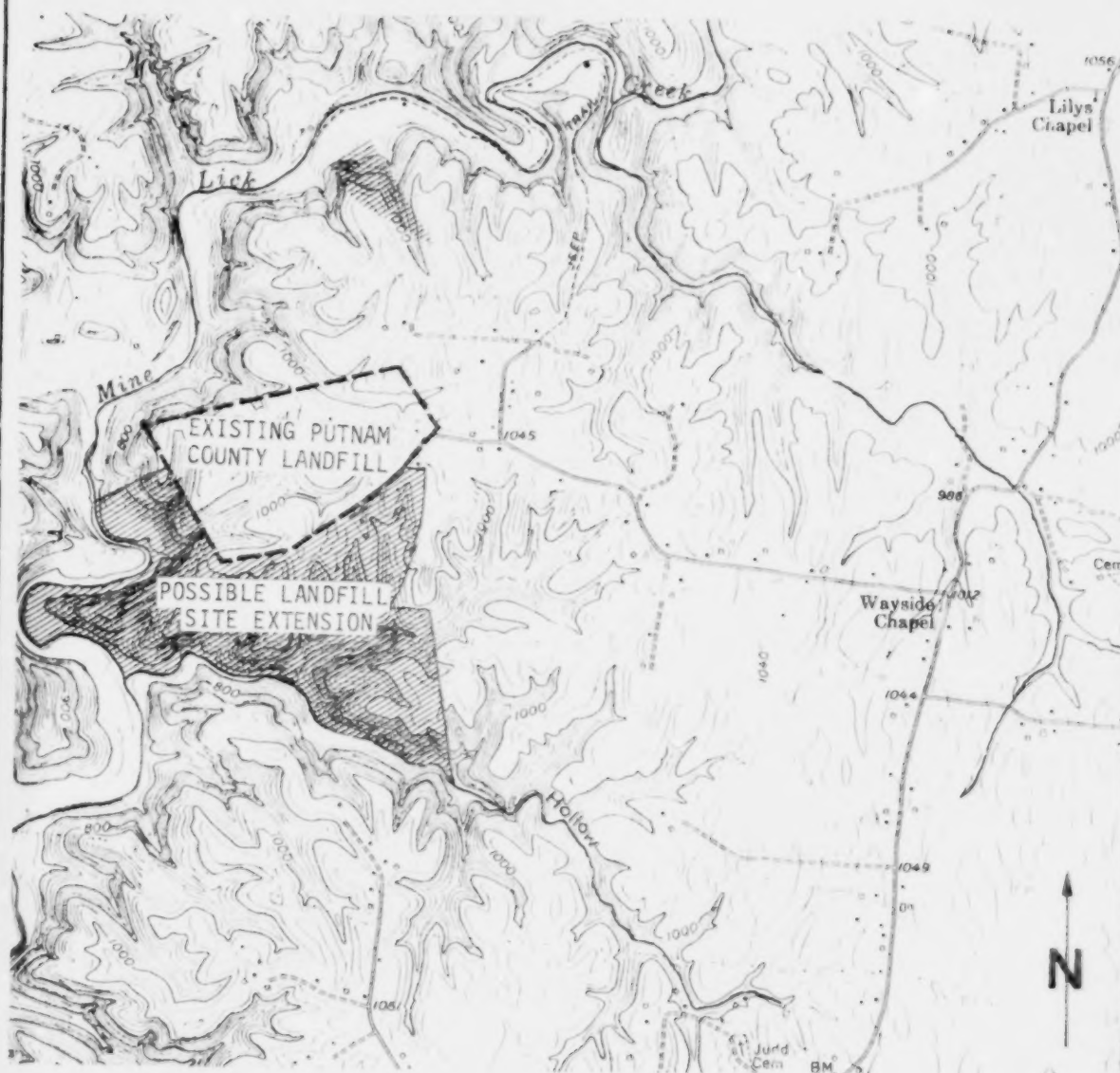
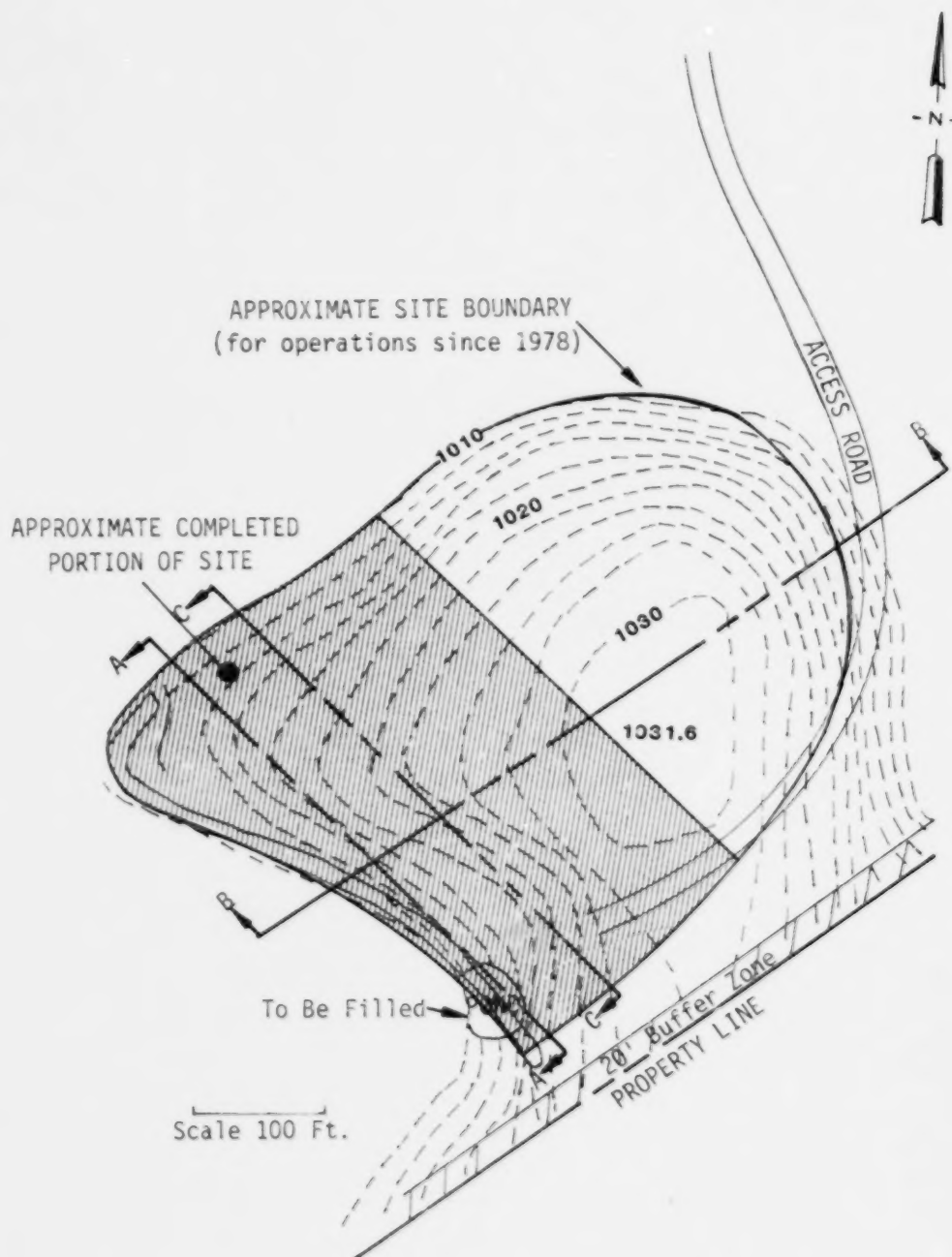


Figure 4.6 shows existing landfill
with respect to county geography.

FROM: USGS SILVER POINT QUADRANGLE
TENNESSEE
7.5 MINUTE SERIES (TOPOGRAPHIC)

PUTNAM COUNTY LANDFILL PRESENT CONSTRUCTION AREA

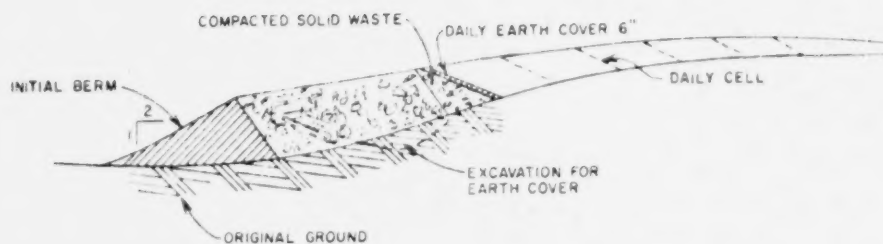


from Upper Cumberland Development District - drawings (undated)

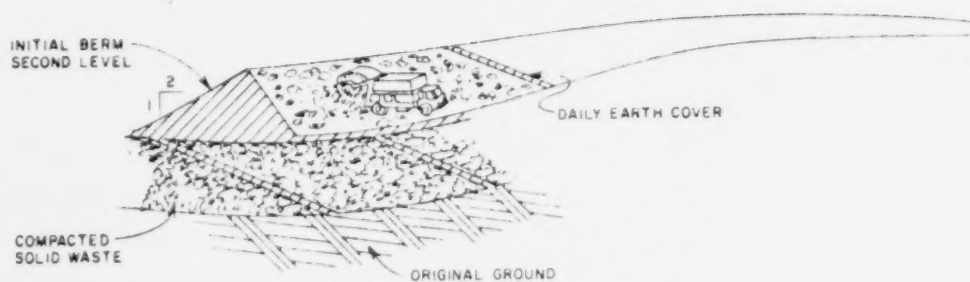
58<

PUTNAM COUNTY LANDFILL PRESENT CONSTRUCTION METHOD

(1) TYPICAL VIEW OF INITIAL BERM
AND DAILY CELL OPERATION



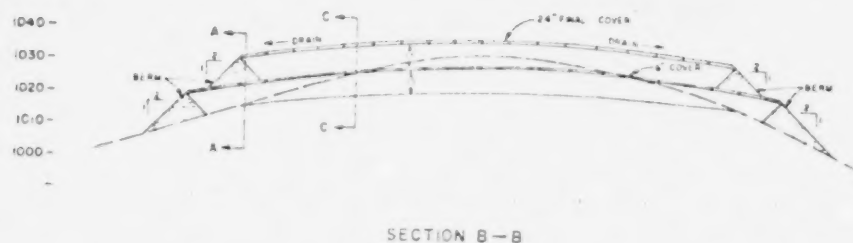
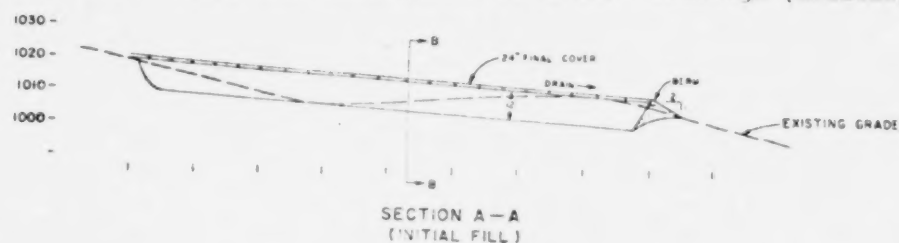
(2) TYPICAL VIEW OF SECOND LIFT
AND DAILY CELL OPERATION



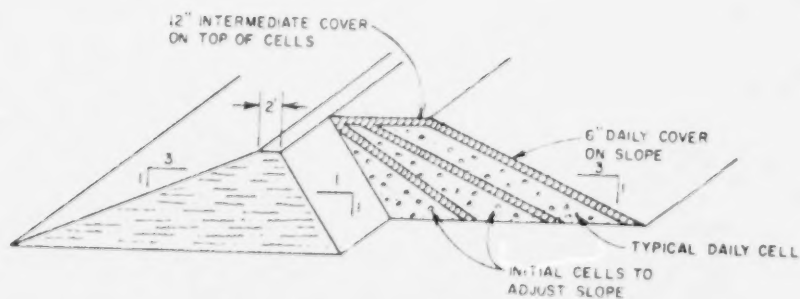
AREA METHOD OF OPERATION

from Upper Cumberland Development District - drawings (undated).

LANDFILL SECTIONS (See FIGURE 4.2) from Upper Cumberland Development District - drawings (undated).



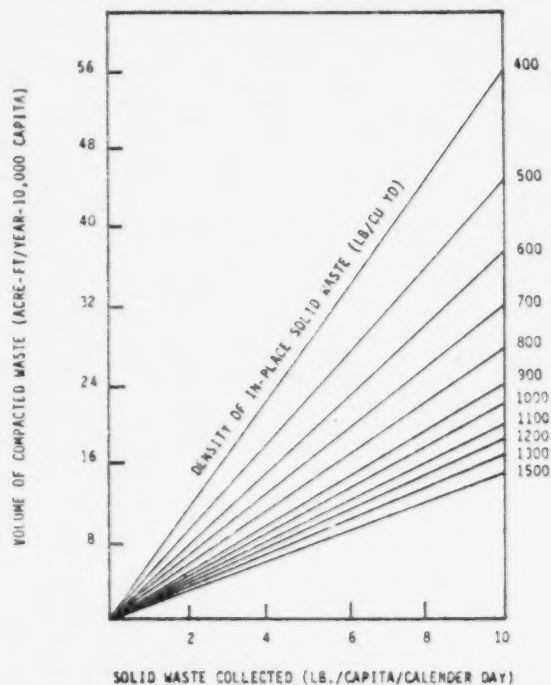
TYPICAL DAILY CELL



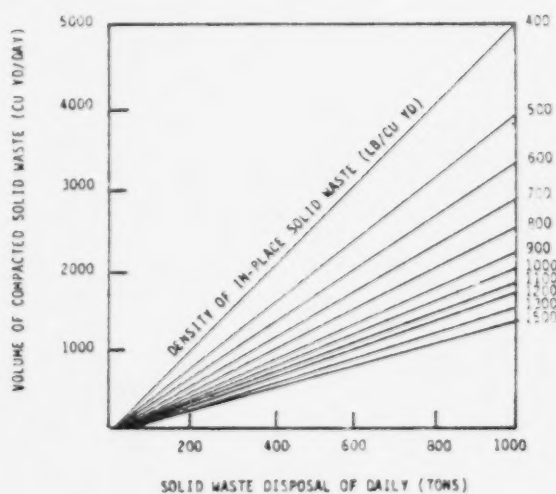
SCALE: NONE

FIGURE 4.5

LANDFILL VOLUME REQUIREMENTS



(A) YEARLY VOLUME OF COMPACTED SOLID WASTE GENERATED BY COMMUNITY OF 10,000

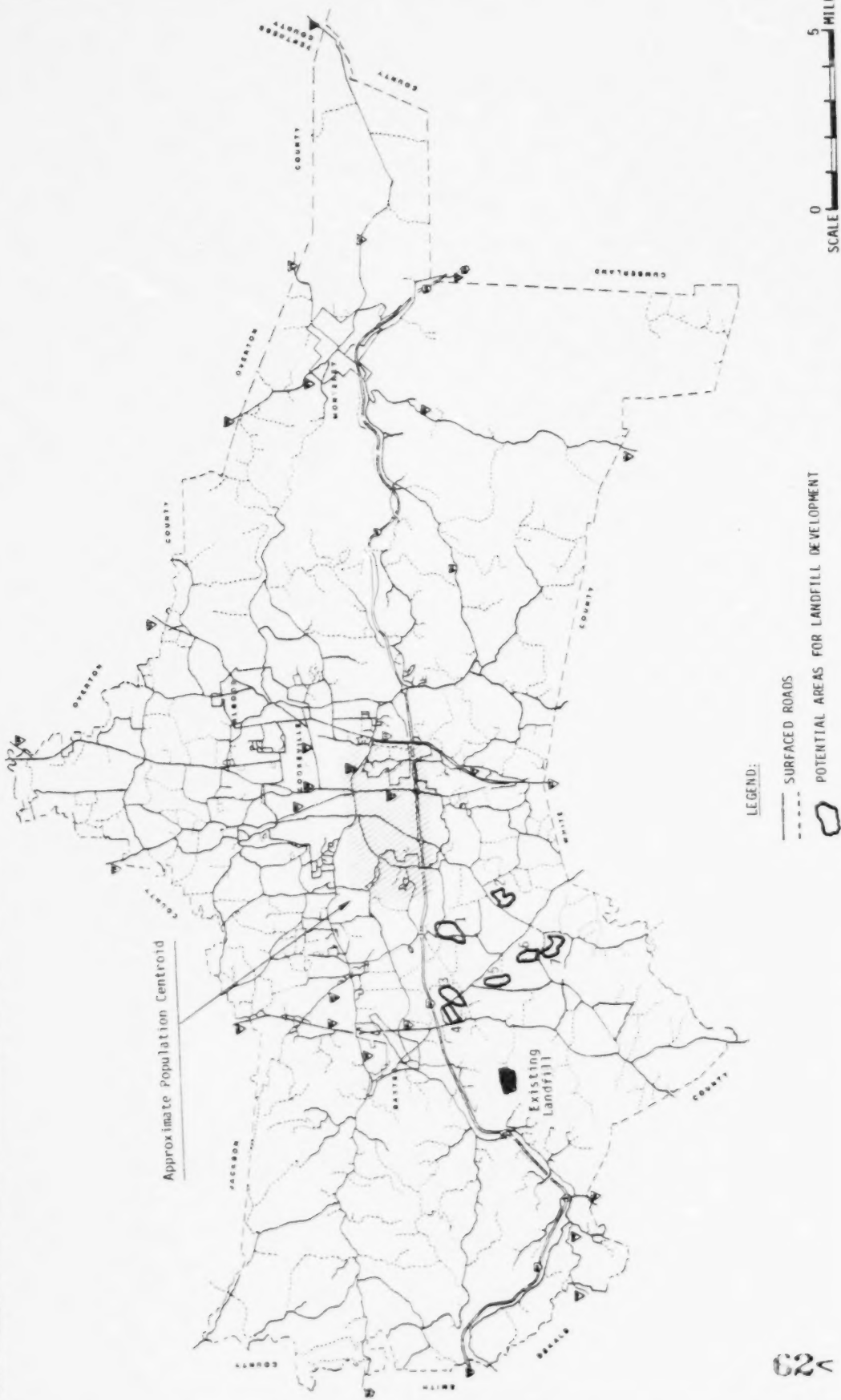


Ref: 9.

(B) DAILY VOLUME OF COMPACTED SOLID WASTE GENERATED BY LARGE COMMUNITIES

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SEVEN POTENTIAL LANDFILL LOCATIONS



The seven sites were selected based on a previous study completed by Tennessee Tech staff. Review of the rating method used to select the sites reveals a few inconsistencies, but for the most part, the students and faculty advisor performing the study did a fine job and identified what appear to be seven sites suitable for landfill development.

Haul distance, or proximity to generator is a very important factor to be considered when siting a waste disposal facility. Sites 1 and 2 are closest to Putnam County's population centroid. In order of closeness, the remaining sites are 4,3,7,6 and 5. All of the sites appear to have good to excellent topography and soils (based on a cursory review of surface soil characteristics), and are located in areas of little or no existing development. Site 4 is more heavily wooded than the other sites.

Based on available information, it appears that each of these sites is capable of development as a landfill. It should be pointed out, however, that much more detailed site specific information is necessary prior to selecting a site. It is also probable that there are more than these seven sites appropriate for landfill development.

DEVELOPMENT OF AN ALTERNATIVE SITE

The disposal of solid wastes into or on the land surface is regulated by both State and Federal regulations. The prime objectives of these regulations are as follows: the protection of the public health and environment, the development and implementation of the solid waste management plans and the development of resource conservation and recovery programs. The major regulations which will impact upon the disposal of solid waste within the State of Tennessee are summarized below.

Landfill Regulations

The Tennessee Solid Waste Disposal Act, Tennessee Code Annotated Sections 53-4301 - 53-4315, - 53-4321 govern development of landfills within the state.

The Resource Conservation and Recovery Act (RCRA) of 1976 (PL 94-580) provides for the development of Federal and State programs

to regulate land disposal of waste materials and for the development of resource recovery programs. The Act was promulgated to regulate the generation, transportation, treatment and disposal of all solid wastes; phase out the use of open dumps for disposal of solid wastes; and to promote the conservation of natural resources through the management, reuse or recovery of solid and hazardous waste.

Proposed Guidelines for Landfill Disposal of Solid Wastes were issued under Section 1008 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 (Federal Register, March 26, 1979). The Proposed Guidelines describe recommended considerations and practices for the location, design, construction, operation and maintenance of solid waste landfill disposal facilities. The purpose of the Proposed Guidelines is to publish "suggested guidelines" that "provide a technical and economic description of the level of performance that can be attained by various available solid waste management practices (including operation practices) which provide for the protection of public health and the environment." A brief summary of the Proposed Guidelines follows:

1. Site Selection (Section 241.200) - This section emphasizes site selection for the landfill disposal of solid waste should be accomplished in consideration of the areal ground and surface water conditions; geological and topographical features; social, geographic and economic factors; and environmental impacts. Environmentally sensitive areas (wetlands, floodplains, critical habitats of endangered species, permafrost areas and recharge zones of sole source aquifers) should be avoided. Zones of active faults and karst terrain are areas that should also be avoided.
2. Design (Section 241.201) - Various topics which should be addressed during the design stage of landfill development are discussed in this section. The value of a clear presentation of all design features is emphasized. Appropriate plans to facilitate review by the appropriate regulatory authority

as well as to facilitate operation in accordance with the original design must be clear.

3. Leachate Control (Section 241.202) - This section addresses the potential for adverse impact on ground and surface water by landfill disposal of solid waste. It also recommends the application of techniques to achieve containment of the solid waste through placement of very low permeability materials on the bottom and sides of a landfill (liner) and sealing of the surface of the completed landfill (cap). Diversion of surface runoff away from or around the landfill (diversion structure design to divert the ten-year 24-hour precipitation event) is also suggested. Liner material permeability requirements (1×10^{-7} cm/sec) and minimum thickness (one foot-are specified.
4. Subsequent sections address the recommended methods for Gas Control (Section 241.203), Runoff Control (Section 241.204), Landfill Operation (Section 241. 205) and Monitoring (Section 241.206).

In addition to the proposed Guidelines, EPA issued Criteria for Classification of Solid Waste Disposal Facilities and Practices under Section 4004 and 1008 of the Act (Federal Register, September 13, 1979). These Criteria establish performance standards (based on environmental protection) which a land disposal facility must achieve to avoid designation as an "open dump." The Criteria were proposed to regulate the impact of a landfill on:

1. environmentally sensitive areas
2. surface water
3. groundwater
4. air
5. land use for the production of food-chain crops
6. disease vectors
7. various other safety hazards, including explosive, toxic or asphyxiating gases, fires and bird hazard to aircraft.

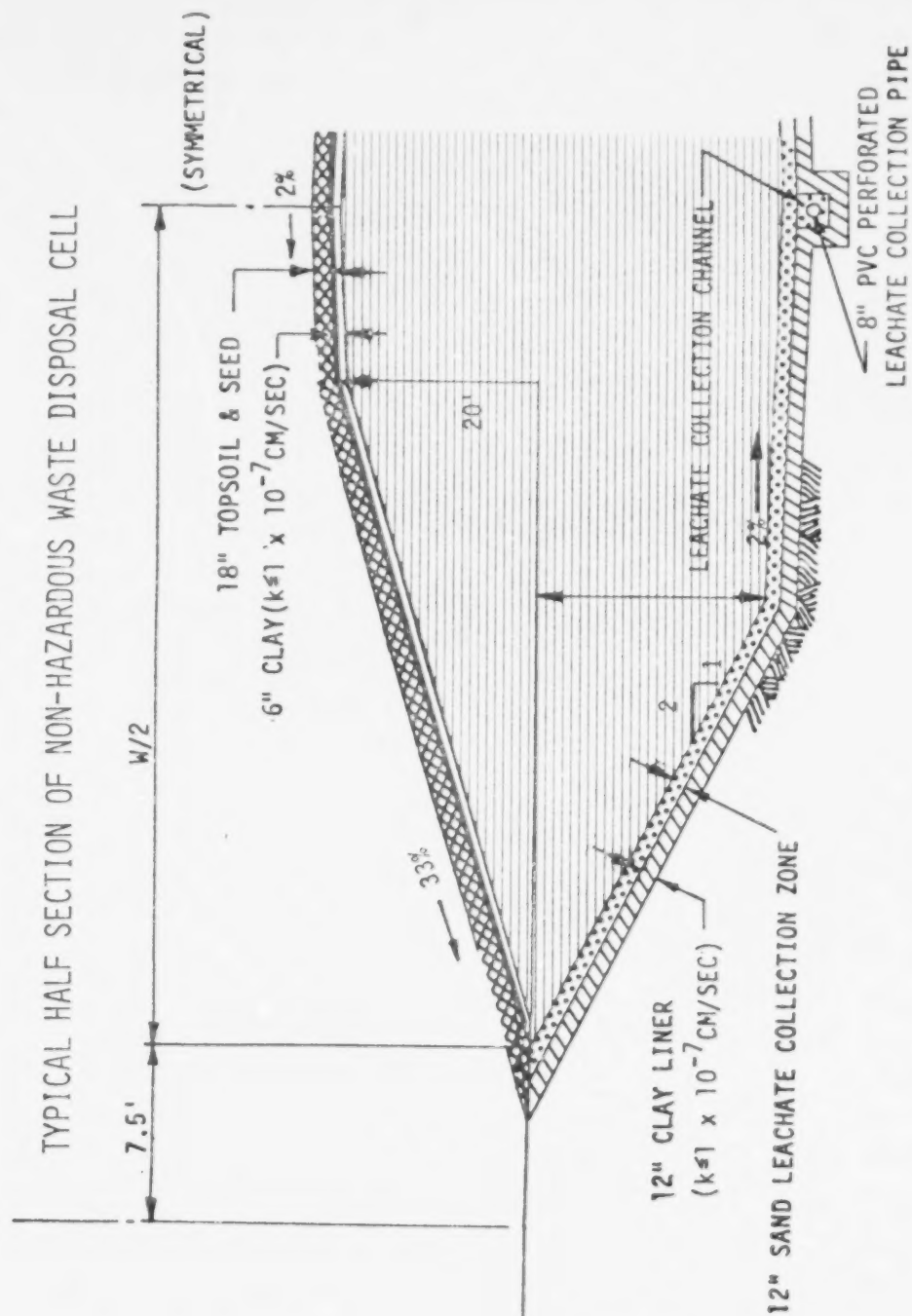
Landfill Siting and Design

A typical non-hazardous waste landfill cross section is illustrated in Figure 4.7. The design includes impermeable clay liner and cap, as well as leachate collection provisions. The requirements of RCRA Section 4004 and 1008 also include provisions for groundwater monitoring and other environmental considerations.

The primary components of a landfilling operation are the site itself, the equipment used, the personnel required to operate and monitor the site, and the site structures. Sufficient personnel and equipment are required for hauling, waste handling, earth moving, placement and compaction, and monitoring. The site structures should provide shelter and sanitary facilities for the operating personnel and storage for the equipment.

The landfill site should be located within a reasonable hauling distance of the waste production centroid. In general, a site with sufficient distance above the groundwater table, out of the floodplain and with soils of low permeability is most desirable. Prior to selection of a landfill site, detailed geologic and hydrogeologic information should be obtained. Typical information to be collected should include:

- Soil Borings (complete logs) - depth to bedrock
 - lithology and hydrologic characteristics of bedrock formation
 - name, age and structural characteristics of the formations encountered during the boring operation and/or which crop out on or adjacent to the site
 - depth and elevation of the water level in the borehole
 - soil textural classification
 - particle size distribution of soil samples
 - coefficient of permeability of soil samples
 - ion-exchange capacity and ability to absorb and fix heavy metal ions.
- Hydrologic Information
 - groundwater table level and fluctuation
 - vertical and horizontal components of the hydraulic gradients
 - an analysis of the background groundwater quality
 - surface drainage patterns



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The hydrogeology of a site is one of the most important factors used to determine ultimate suitability and will greatly influence the final design of the the facility. Not only is it extremely important to determine the affect of the hydrogeologic regimen on the landfill operation, it is equally important to predict the affect of the landfill operation on the hydrogeologic regimen.

In addition to hydrogeologic data, other information must be collected and evaluated during the preliminary site investigation program. Additional information which should be evaluated includes:

- surrounding land use patterns
- location of structures, roads and utilities
- property line survey and evaluation of easements or right-of-ways
- evaluation of potential problems such as leachate and gas generation
- site access and traffic patterns
- evaluation of final land use
- evaluation of zoning restrictions

As a general rule, it is usually desirable from a technical and economic viewpoint to dispose of the solid waste at a point nearest to where it is generated, but it is recognized that this is not always possible.

OPERATIONS PLAN

In order to obtain the maximum use from construction of a new landfill it is important to maintain an effective operating plan. While all the steps in the landfilling process are important, proper operation of a site should receive the most attention. A well-operated site will cost less to operate, extend landfill life, optimize the use of manpower and equipment, minimize maintenance problems and the area can be more easily turned into a community asset such as a park, golf course or other post-closure usage.

The best designed disposal facility will be of little value unless it is constructed and operated as prescribed. This is especially

true of a sanitary landfill because it is under construction up to the day the last load of solid waste is disposed. Constructing the sanitary landfill on a daily basis in accordance with the design should be unequivocally required in an operations plan.

An operations plan is essentially the specification for construction and operation and it should contain all items required to construct the sanitary landfill. It should describe: 1) hours of operation, 2) measuring procedures, 3) traffic flow and unloading procedures, 4) designation of specific disposal areas and methods of handling and compacting various solid wastes, 5) placement of cover material, 6) maintenance procedures, 7) adverse weather operations, 8) fire control, 9) litter control, 10) salvaging operations, if permitted, 11) emergency procedures and telephone numbers etc.

Proper operation calls for drawing up a comprehensive plan that spells out routine procedures and anticipates abnormal situations. It must also provide continuity of activities even when personnel changes occur. New supervisors and personnel responsible for solid waste disposal must know what is being done at the landfill and why. The plan must, however, remain open for revision when necessary. Changes should be noted and the rationale behind them explained. New personnel will benefit from the experience of others and continuity of operations will be preserved.

The plan should also be used as a tool in training employees, defining their jobs, and giving them an insight into the work of others. In this manner, the employee will more fully understand the overall operation and he may be able to perform other duties in an emergency.

While operation plans differ from site to site, the basic issues to be addressed are fairly standard. The items that should be addressed in a disposal site manual are presented in Table 4.1, an outline for a typical operations plan.

Improved operating efficiency translates into direct cost savings. On a dollar basis, operating expenses far outweigh initial design and other capital costs. The operating costs are often two to four times the annualized capital cost for a landfill facility.

TABLE 4.1
OUTLINE FOR TYPICAL OPERATION PLAN

- I SCOPE
 - A. Introduction
 - B. Special provisions
 - C. Site description
 - D. Site development
 - E. Site volume
- II GENERAL LANDFILL INFORMATION
 - A. Entrance area preparation
 - B. Subgrade preparation
 - C. Groundwater and leachate control
 - D. Internal roadway system
 - E. Detailed landfilling process
 - F. Clay seal construction
 - G. Monitoring system
 - H. Operational controls
 - 1. Line and grade
 - 2. Earthmoving estimates
 - 3. Refuse weighing and classifying
 - 4. Adverse weather conditions
 - a. Wet weather
 - b. Cold weather
 - 5. Safety
 - a. Fire prevention
 - b. Odor control
 - c. Vector control
 - d. Salvaging
 - e. Accident prevention and safety
 - 6. Personnel
 - I. Maintenance control
 - 1. Dust control
 - 2. Litter control
 - 3. Surface runoff handling
 - a. Drainage measures
 - b. Erosion controls
 - 4. Equipment
- III SPECIFIC LANDFILL INFORMATION
 - A. Entrance area preparation
 - B. Bottom grades and leachate collection system
 - C. Existing contours, grid control, sequencing and boring locations
 - D. Detailed filling of sequences 1 and 2
 - E. Filling of sequences 4, 5, and 6
 - F. Abandonment and closure plan

CHAPTER 5

PRELIMINARY ASSESSMENT OF RESOURCE RECOVERY

INTRODUCTION

A preliminary assessment of the potential for materials and/or energy recovery was to be performed using extensive data and relevant background information thought to be available from the State of Tennessee. Soon into this task, however, it was learned that extensive information on potential materials markets exists but only limited information exists relative to energy recovery opportunities. As a consequence, this chapter addresses the potential of energy recovery for Putnam County in an overview fashion.

Materials Recovery

Appendix A is a comprehensive listing of existing markets for various materials typically contained within the solid waste stream. Of the potential markets contained within this appendix, several appear to be within reasonable economic transport distance. Based on the present Putnam County solid waste collection and disposal practices, a limited materials recovery program implemented at the landfill site appears to offer the most potential for success. Under such a program, readily recovered materials for which a market can be found, such as white goods (i.e., refrigerators, stoves, and other appliances), and concentrations of corrugated paper could be picked out of the waste delivered to the landfill.

The major advantages to such an approach are low cost, ease of implementation and the obvious impact of reducing volumes of materials requiring burial thereby extending landfill life.

The following subsections present brief descriptions of the most common approaches to materials recovery including disposal area segregation, in order of increasing complexity.

Ordinance

The landfill could refuse to accept a particular waste type if Putnam County passes an ordinance designed to control traffic of certain wastes. In other counties, ordinances such as this have stabilized the market and increased the prices. This approach is practical only when there is another way of recovering the diverted material. Categories of waste can be excluded from the landfill if long-term outlets are available. For example, corrugated paper generated by industries or commercial establishments could be sent directly to paperstock dealers; white goods generated by citizens could be picked up by special arrangement with a local scrap dealer; or clean rubble from demolition projects could be directed to land reclamation areas where "clean fill" can be safely used. This alternative would make it the responsibility of solid waste generators (citizens and companies) to recycle certain resources.

Disposal Area Segregation

With this approach, uncontaminated waste streams delivered to the landfill are stored separately from other waste for later sale or reuse. Some of the materials stored in this way, and some typical methods of handling them, are shown in the following table:

<u>Material</u>	<u>Method/Use</u>
Trees, waste lumber	Stored in designated area. Available to citizens as firewood.
Brush	Chipped by Putnam County (or the landfill operator). Available for public works or citizen use.
Leaves	Windrow compacted by the County. Compost available for public works or citizens use.
Tires	Stored in designated area. Portion to tire recappers; remainder stored for future potential energy recovery.

<u>Material</u>	<u>Method/Use</u>
White goods: miscellaneous bulky ferrous metal	Stored in designated area. Sold to scrap dealers.
Stabilized ¹ sewage sludge	Stored in designated area. Used as topsoil blender for final landfill cover.

It is felt that some of the above materials, specifically trees, brush, tires, and white goods, should be considered by Putnam County for incorporation into a segregated disposal area.

Recycling Centers

Of all methods of materials recovery, direct delivery of materials by citizens to recycling centers is best known and most widely practiced. The largest portion of the post-consumer wastes recovered is delivered to recycling centers. Centers can be established at solid waste disposal areas, transfer stations, or other convenient locations; they may be staffed by volunteers, or run by public or private companies. The materials recovered at recycling centers are those commonly found in residential refuse (e.g., glass, newsprint, aluminum, tinne steel cans).

The major advantages of using recycling centers are their simplicity, low start-up costs, and the high quality of the material recovered. However, few communities can achieve a waste stream reduction of more than 5 to 10 percent.

Curbside Pickup

With this approach, source-separated materials are left at curbside for recovery at prescribed intervals. Householders store the materials (newspapers, glass separated by color, aluminum containers)

¹Stabilized according to state environmental and public health regulations. Authorized methods may include digestion, lime stabilization, and composting. The Putnam County landfill does not currently receive these wastes, however, at some time in the future (after the Federal and Tennessee RCRA regulations are promulgated) the landfill may receive sewage sludges.

from mixed refuse. One method of collection requires the separated materials to be set out weekly with the mixed refuse on the normal collection day; collection crews place the recycleable materials in racks mounted on (or trailers towed by) the refuse collection vehicle, or separate crews collect recyclables with special vehicles. Other possible collection methods are to use municipal crews, private contractors, or volunteers (Boy Scouts or Girl Scouts) on a less frequent basis.

Curbside collection can recover yields of medium-to-high quality material amounting to 10 to 20 percent of the waste stream. In well-run programs, the cooperation of large percentages of residents has been realized, and collection costs have been offset by materials sales and decreased disposal costs. The method is normally suited, however, only to municipalities with organized collection systems and the capability to manage such a complex undertaking such as Cookeville, Monterey, Baxter and Algood. A curbside source-separation program can complement an energy recovery system by 1) increasing the total tonnage recovered, i.e., decreasing the amount to be landfilled; 2) decreasing the tip fees that the energy recovery system must charge a town, especially when large hauls are involved; and 3) reducing the glass content of the waste stream which reduces the abrasion of plant machinery and ash content of the fuel.

Energy Recovery

Tennessee Technological University and Putnam County Hospital were identified as two prospective customers for resource-recovered energy. Based on preliminary information, it appears that both have energy practices and requirements compatible with the concept of energy resource recovery. Information from Tennessee Tech indicates that its average energy requirements are equivalent to the net energy content of 107 TPD₇ of municipal solid waste (MSW). Information obtained from Putnam County Hospital indicates an energy demand equivalent to approximately 68 TPD₇. These figures are based on historical energy consumption obtained during discussions with the University and the Hospital as summarized in Table 5.1.

TABLE 5.1
HISTORICAL ENERGY DEMAND - TENNESSEE TECH
AND PUTNAM COUNTY HOSPITAL

<u>Tenn. Tech. Fuel Consumption (FY 1979-80)</u>			
	<u>Gas (Therm)</u>	<u>Oil (gal)</u>	<u>Coal (Tons)</u>
July	66,000	-	-
August	66,000	-	-
September	50,000	-	-
October	77,000	-	-
November	94,000	-	-
December	252,000	-	-
January	297,000	-	-
February	132,000	-	-
March	153,000	-	-
April	289,000	-	-
May	149,000	-	-
June	<u>110,000</u>	<u>-</u>	<u>-</u>
Total	1,735,000	80,000	3,500

Total Heat Requirement for 1979 = 2.72×10^{11} BTU's/Yr.

Equivalent to 39,000 Tons/Yr. Refuse Fuel

Putnam County Hospital Fuel
Consumption (1977)*

<u>Gas</u>	<u>Oil</u>
146,617 MCF	10,000 Gallons

Total Heat Requirement (1977) = 1.77×10^{10} BTU's/YR.

* Add 20% for 1980 Floor Space (Due to 1978 Building Addition).

Equivalent to 24,700 Tons/Yr. of Refuse Fuel

Factors

Therm	= 100,000 BTU's
Oil	= 146,000 BTU's/Gal.
Gas	= 1,200 BTU's/Ft ³
Coal	= 12,500 BTU's/lb.
Municipal Solid Waste (MSW)	= 4,500 BTU's/lb.*

*This assumes 84% boiler efficiency for natural gas and 65% for MSW

These preliminary findings indicate that energy resource recovery may be a viable solid waste management option. Additional study is necessary, however, to determine if resource recovery is likely to be both an economically and technically sound disposal alternative.

Commercially demonstrated resource recovery technologies capable of converting less than 100 to greater than 2000 tons per day (TPD) of municipal solid waste (MSW) into usable energy exist. Potential energy forms include refuse-derived fuel (RDF) for firing in solid fuel boilers; low- or high-temperature steam for manufacturing processes, and heating/cooling applications; high-temperature gas (air) for drying furnace applications and electricity.

The viability of energy recovery from solid waste is dependent on five basic ingredients:

1. Potential energy buyers who could use all or most of the energy recovered from the available processible waste.* These buyers typically have the technical capability to use recovered energy; rely on high-cost fuels such as natural gas or oil; operate continuously (three shifts, 5, 6, or 7 days per week); are financially healthy and viable over the long term; are located near both the available waste supply and a suitable site for a resource recovery facility; and are interested in the concept of resource recovery.

2. A sufficient tonnage of processible solid waste, from which energy and/or materials could be recovered to meet the requirements of or more potentially viable buyer.*

The economics of resource recovery are based primarily on energy output and revenues, so sufficient processible (combustible) waste must be available to provide adequate revenues. Because as much as 35 percent of the waste stream may be oversized or noncombustible materials, and because a portion of waste generation typically cannot be captured, care must be taken in determining the appropriate capacity for a given resource recovery system.

* Processible solid waste is that tonnage which could be processed in a resource recovery facility. Unprocessable materials include oversized bulky waste (e.g., large metal objects, bed springs, rugs) and white goods.

3. Potentially available sites that are well situated with respect to the shipment of solid waste and the delivery of energy to prospective buyers. These sites must be environmentally and physically suitable; for systems producing hot water, steam, or high-temperature gas the site must be contiguous to the energy customer. For systems producing RDF or electricity siting is less of a constraint.

4. Resource recovery technologies that can reliably process available waste and produce energy and/or saleable materials in the form, quantity, and quality required by prospective buyers. Because the prospective energy market will require energy continuously, and waste transport and disposal is typically intermittent, any resource recovery system must address reliability.

5. A total disposal cost that is competitive with the costs of alternative disposal methods available to participating communities. Energy recovery is one of several environmentally sound solid waste management options. The economic attractiveness of resource recovery must be evaluated against the costs of other environmentally suitable disposal options.

If a preliminary feasibility study indicates the presence of these five ingredients, further feasibility work prior to implementation of a project is required. More specifically, the local government should:

1. Ascertain the level of interest of prospective energy customers. Perform more detailed evaluations of their energy practices and requirements including detailed energy load profiles with hourly, daily, and seasonal variations; aggregate current and projected fuel costs; and electrical, water, and other utility charges.
2. Establish a weighing program to find out if sufficient solid waste is available, and perform an analysis of waste composition to ascertain that the waste has a sufficient energy value to satisfy the requirements of potential energy buyers. In addition, determine the seasonal fluctuations in waste quantity and composition.

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3. Determine who controls the various portions of the waste stream and develop strategies to ensure that the waste generated can be directed to a resource recovery facility.

If these three tasks confirm the potential feasibility of the projects identified, a detailed feasibility study should be performed. Such a study will enable the decision makers to decide whether to proceed toward resolving project implementation issues, including system performance requirements, risk management, procurement, and financing.

In considering resource recovery, it is important to be aware that:

- More than 20 percent of the waste stream will require ultimate landfill disposal, even if resource recovery is implemented. This waste includes oversized, bulky materials and noncombustibles which are diverted from the project, and residues of combustion. The cost of this landfilling has been taken into account in developing the economic projections.
- The lead time for a resource recovery project is significant. For example, implementation of a modular combustion system requires a minimum of 24 months after procurement contracts are executed. This lead time suggests mid-1983 as the earliest date for a fully operational system.
- Until recently, industry viewed recovered energy as lower in quality and less reliable than other types of energy and expected the price of the recovered energy to be lower. This expectation is beginning to change as industrial concerns recognize that resource recovery offers them energy self-sufficiency.

Table 5.2 lists seven modular combustion systems which have been installed ranging from 16 tons per day (TPD) to 150 TPD. The respective adjusted 1980 capital costs are also shown in the table. These represent one energy recovery system which may have potential in communities with modest waste production quantities.

TABLE 5.2
MODULAR INCINERATORS
SMALL VOLUMES

	<u>Location</u>	<u>Capacity (TPD)</u>	(Millions) <u>Capital Cost 1980 (\$)</u>
Plant A =	Auburn, Maine	150	3.5
Plant B =	Dyersburg, Tenn.	100	2.0
Plant C =	Genesee Township, Tenn.	100	2.0
Plant D =	Lewisburg, Tenn.	60	1.75
Plant E =	North Little Rock, Ark.	100	1.90
Plant F =	Salem, Va.	100	1.90
Plant G =	Siloam Springs, Ark.	16	0.60

Source: Solid Waste Management November, 1979

Supplemented by Engineering-Science Phone Contacts and Verifications.

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APPENDIX A POTENTIAL MATERIALS RECOVERY MARKETS IN
 TENNESSEE



STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH

CORDELL HULL BUILDING
NASHVILLE, TENNESSEE 37219

**COMMERCIALLY AVAILABLE
FACILITIES IN TENNESSEE
FOR THE RECYCLING
OR OTHER MANAGEMENT
OF WASTES**

This listing of facilities was compiled principally from a review of selected telephone directories across the state, augmented with information from the files and staff of the Division of Solid Waste Management. It should not be totally relied upon for completeness or accuracy. Also, the presence of a facility on this list does not mean that that facility is approved by this Department. Further information on given facilities or on the management of a given waste may be obtained from the Division at the following addresses and telephone numbers:

East Tennessee

Tennessee Division of Solid
Waste Management
1233 Southwest Avenue Extension
P. O. Box 1787
Johnson City, Tennessee 37601
615/928-8304

Tennessee Division of Solid
Waste Management
1522 Cherokee Trail
Knoxville, Tennessee 37920
615/546-9221

Middle Tennessee (headquarters)

Tennessee Division of Solid Waste Management
326 Capitol Hill Building
301 Seventh Avenue North
Nashville, Tennessee 37219
615/741-3424

West Tennessee

Tennessee Division of Solid Waste Management
210 Oakmont Towers
646 Old Hickory and U.S. 45 Bypass
Jackson, Tennessee 38301
901/668-1315



STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
CORDELL HULL BUILDING
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Tennessee Division of Solid Waste Management
210 Oakmont Towers
646 Old Hickory and U.S. 45 Bypass
Jackson, Tennessee 38301
901/668-1315

OCT 22 1979

PAPER RECYCLING

<u>Facility</u>	<u>Capabilities</u>
1. City of Lawrenceburg George Marston, County Environmentalist 406-B Gaines Street Lawrenceburg, Tennessee 38464 615/762-9406	Paper bailing
2. Thomas N. Hale, County Environmentalist 113 Maple Street P.O. Box 98 Camden, Tennessee 38320 901/584-4944	Paper bailing
3. Jim Cosman B. F. I. of Nashville 85 Woodard Street Nashville, Tennessee 615/242-6533	
4. Alton Box Board Company 707 - 19th Avenue, North Nashville, Tennessee 615/329-4855	All grades of waste paper except mixed grade (magazine, telephone books, etc.)
5. Packaging Corporation of America 100 Riverhills Drive Nashville, Tennessee 615/889-0605	Recycle newspaper, corrugated, ledgers, tab cards and mixed papers
6. Recycled Fiber Company 410 Frazier Street Knoxville, Tennessee 37917	
7. Alton Box Board Company Paper Reclaiming Division Bluff City Plant 1131 - 69 Agnes Place P.O. Box 2002 De Soto Station Memphis, Tennessee 901/275-3151	Paper reclaimer, corrugated (all grades) and newspaper
8. H. Blockman and Company 376 N. Front Memphis, Tennessee 901/526-6545 or 901/685-5189	Wastepaper, corrugated and newspaper, old tab cards Industrial accounts
9. Dixie Waste Paper Company 2747 Jackson Avenue Memphis, Tennessee 901/327-9398	Buyers of all grades of waste paper, open to public

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|-----|---|---|
| 10. | Memphis Waste Paper, Inc.
704 Dudley South
Memphis, Tennessee
901/774-3110 | Industrial Accounts, Solicited,
Containers furnished |
| 11. | Chattanooga Recycled Fiber Company
2900 Home Drive
Chattanooga, Tennessee
615/267-0097 | All grades of wastepaper,
corrugated, newspaper, mixed
paper, computer, TAB cards |
| 12. | TRI-STATE Recycle Center, Inc.
Cumberland
Chattanooga, Tennessee
615/629-0096 | Scrap Paper |
| 13. | Paper Stock Dealers, Inc.
1111 Mitchell 1st, NE
Knoxville, Tennessee
615/524-0309 | Old corrugated boxes, newspapers
magazines, computer paper,
tabulating cards |
| 14. | TRI-City Waste Paper, Inc.
501 Riverport Road
Kingsport, Tennessee
615/246-7801 | Wastepaper, newspaper, IBM
Cards, ledgers |
| 15. | Shelbyville Recycling Center
212 1/2 Deery
Shelbyville, Tennessee
615/684-3461 | Newspaper and Bags |
| 16. | Clark Iron and Metal Company, Inc.
217 Hillard
Murfreesboro, Tennessee
615/893-7281 | Paper recycling |
| 17. | Sanford & Sons Recycled Materials
28 Monroe Avenue
Brownsville, Tennessee
901/772-3262 or 901/772-0237 | Cardboard, newsprint, all types
of paper |

OCT 22 1979

SCRAP RUBBER

<u>Facility</u>	<u>Capabilities</u>
1. F. Perlman and Company, Inc. 476 Manassas North Memphis, Tennessee 901/526-7651	Scrap Rubber
2. H. Blackman and Company 376 North Front Memphis, Tennessee 901/526-6545 or 901/685-5189	Scrap Rubber

OCT 22 1979

PAPER SHREDDER

Facility

Capabilities

- I. Southern Excelsion Company
Highway 100
Fairview, Tennessee 37062
615/799-0218

OCT 22 1979

SCRAP PLASTICS

Facility

Capabilities

1. Belco Plastic Brokerage Company
3335 Ambrose Avenue
Nashville, Tennessee
615/262-5105

OCT 22 1979

ANIMAL RECYCLING

Facility

1. Nashville Recycling Company
10 Van Buren
Nashville, Tennessee
615/244-5423

Capabilities

Animal By-Products

OCT 22 1979

WASTE COTTON, WOOL, ETC.

<u>Facility</u>	<u>Capabilities</u>
1. Sperril Coal Company 415 N. Market Chattanooga, Tennessee 615/266-1556	
2. Steiner-Liff Iron & Metal Co. 710 South 1st Street Nashville, Tennessee 615/242-3553	Cloth
3. Lee Wiper Material Co. 8 East 38th St. Chattanooga, Tn. 615-266-2604	Cloth

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SCRAP IRON AND METALS

<u>Facility</u>	<u>Capabilities</u>
1. M. Cohen Iron & Metal Co. 724 South 2nd Street 810 17th Avenue, North Nashville, Tennessee 615/254-9404 or 615/329-3366 Nashville, Tennessee	Iron, Tin, Metals & Batteries
2. Steiner-Liff Iron & Metal Co. 710 South 1st Street Nashville, Tennessee 615/242-3553	Heavy & Light Iron, Scrap Autos, Non-Ferrous Metals
3. Abbott, Connley and Finch 1654 Monroe Avenue Memphis, Tennessee 901/725-9275	Aluminum, Copper, Lead, and X-rays neg.
4. Airways Iron & Metal Company 2103 East Pearson Avenue Memphis, Tennessee 901/276-6346	Scrap Metals
5. City Iron and Metal Company 29 Illinois Avenue, East Memphis, Tennessee 901/774-2183	Scrap Metals
6. H. Iskiwitz and Company 604 Marble Avenue Memphis, Tennessee 901/526-8944	Scrap Metals
7. J & J Scrap Metals 235 South Parkway East Memphis, Tennessee 901/942-1771	Air Conditioners - Compressors, Copper, Brass, Cast Iron, Tin, Batteries, etc.
8. A. Karchmer and Sons, Inc. 477 Tennessee Memphis, Tennessee 901/526-1235	Scrap Metals
9. Lagarov Bros. Tin Compress Company, Inc. 1166 Seventh North Memphis, Tennessee 901/525-0683	Tin, Iron, Metals, Copper, Cast Iron, Aluminum, Batteries, Radiators Container Service and Pick up of Industrial Plant Scrap Metal of all kinds

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| 10. | Mid-America Recycling, Inc.
1701 Thomas
Memphis, Tennessee
901/522-9443 | Scrap Metals |
| 11. | Ben Mogy and Sons
2530 Shasta Avenue
Memphis, Tennessee
901/458-0925 | Tin, Copper, Aluminum, Lead,
Batteries, Radiators, Iron and
Steel |
| 12. | Pat Patrick and Company
245 South Parkway East
Memphis, Tennessee
901/948-1941 | Scrap Metals |
| 13. | F. Perlman and Company, Inc.
476 Monassas North
Memphis, Tennessee
901/526-7651 | Scrap Iron and Metals |
| 14. | Sanitized Steel Co. of Memphis, Tennessee
10W Henry Avenue
Memphis, Tennessee
901/526-7531 | Scrap Metals, Stoves, Ice Boxes,
Washing Machines, and Loose
Tin |
| 15. | South Memphis Iron & Metal Company, Inc.
2250 Third Street
Memphis, Tennessee
901/942-2220 | Service to Commercial and
Industrial Accounts
Salvage Steel, Pipe, Surplus
Items, Iron and Metals |
| 16. | Southern Tin Compress Corporation
1270 North Seventh
Memphis, Tennessee
901/ | Will purchase Plant Inventory
Liquidations, Heavy Scraps,
Light Steel Scrap, Industrial
Clippings, Radiators, Batteries,
Copper, Brass, etc. |
| 17. | H. Blockman & Company
376 North Front
Memphis, Tennessee
901/526-6545 or 901/685-5189 | Iron, Metal, Copper, Waste
Paper, Brass, Batteries,
Radiators |
| 18. | A-1 Wiping Rag Company
1721 Western Avenue
NW Knoxville, Tennessee
615/525-5355 | Scrap Metal Except Scrap Steel |
| 19. | American Iron and Metal Company, Inc.
529 E. 11th Street
Chattanooga, Tennessee
615/266-1737 or 615/266-4634 | Aluminum, Brass, Copper, Lead,
Batteries, Radiators, Steel
and Cast Iron |
| 20. | Ball Scrap Metal
1152 Salem Road
Chattanooga, Tennessee
615/820-9816 | Brass, Copper, Steel, Radiators,
etc. |

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| 21. | CE Met-Division of Combustion Engineering,
Inc.
911 W. Main
Chattanooga, Tennessee
615/265-1859 | Scrap Metal |
| 22. | G. Frumin & Sons
411 W. 22nd
Chattanooga, Tennessee
615/266-5338 | Scrap Metal |
| 23. | Lockwood Auto Center
2317 Bragg
Chattanooga, Tennessee
615/629-2235 | Junked and Wrecked Cars and
Scrap |
| 24. | Richelson Iron and Metal Company
400 East 20th
Chattanooga, Tennessee
615/ | Copper, Brass, Aluminum, Steel
Scraps, Autos, Industrial, Scrap,
Containerized Collection |
| 25. | Seaton Iron & Metal Company
1507 Decatur Pike, N.W.
Athens, Tennessee
615/745-3870 | Scrap Metal |
| 26. | Siskin Steel and Supply Company, Inc.
950 W. 19th
Chattanooga, Tennessee
615/756-3671 | Industrial Scrap |
| 27. | Ben Greenberg Company, Inc.
119 E. Cedar Street or Boothpoint, Tennessee
Dyersburg, Tennessee
901/285-4424 or 901/285-0112 | Scrap Iron and Metal, New
and Used Steel |
| 28. | Bowden Bros. Scrap and Steel Company
407 North Shelton
Covington, Tennessee
901/476-1813 | New and Used Steel, Copper,
Brass, Aluminum
Whole Automobile Motors |
| 29. | Denbo Scrap Materials, Inc.
821 W. College
Pulaski, Tennessee
615/363-3593 | Junk Auto and Appliances |
| 30. | Peachtree Trading, Inc.
1505 Carmack Blvd.
Columbia, Tennessee
615/381-1149 | Scrap Metal |

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|-----|---|---|
| 31. | SS Iron and Metal Company, Inc.
608 W. 11th
Columbia, Tennessee
615/388-3272 | Copper, Brass, Aluminum, Lead,
Batteries, Stainless Steel,
Radiators, Iron, Tin, Cast and
Motors, Industrial Scrap |
| 32. | Carrol Iron and Metal
523 9th SE
Cleveland, Tennessee
615/476-4431 | Industrial and Commercial
Scrap Metal |
| 33. | Wilson DeLay Salvage Yard
208 20th SE
Cleveland, Tennessee
615/476-3582 | Aluminum, Copper, Brass, Scrap
Steel, Zinc, Lead, Sheet Iron,
Batteries, Used Auto Parts |
| 34. | Seaton Iron and Metal Company
1507 Decatur Pike
NW Athens, Tennessee
615/745-3870 | Factory and Industrial Scrap |
| 35. | Goolsby and Sons
337 Blythe Avenue
Gallatin, Tennessee
615/452-5804 | Tin, Iron, Copper, Brass, Steel,
Aluminum, etc.
Junk and Wrecked Autos,
Batteries |
| 36. | STATE Line Used Auto Parts
Center Point Road
Portland, Tennessee
615/325-3470 | Scrap Auto Parts |
| 37. | Silvery Harding Company
107 Margrave
Harriman, Tennessee
615/882-3251 | Scrap Metals |
| 38. | Southern Salvage Scrap Metals
Lower Carter
Harriman, Tennessee
615/882-5669 | Scrap Metals |
| 39. | Joyner's Enterprises Junk & Supplies Center
Decatur Pike
Kingston, Tennessee
615/376-6606 | Scrap Copper & Brass |
| 40. | The Albert Company
440 S. Front
Rockwood, Tennessee
615/354-2575 | Scrap Iron |
| 41. | Rockwood Iron & Metal Company, Division
of Azcon Corp.
W. Rockwood
Rockwood, Tennessee
615/354-0215 | Scrap Metals |

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| 42. Southern Alloy and Metal Corporation
440 S. Front
Rockwood, Tennessee
615/354-2790 | Scrap Iron and Steel |
| 43. AV Dale Junk Yard
1214 Western Avenue, NW
Knoxville, Tennessee
615/523-1226 | Copper, Brass, Radiators,
Batteries, Angle Irons, Pipe -
All Kinds of Fittings and
All Kinds of Scrap |
| 44. Knox Metals Corporation
822 Richards, NW
Knoxville, Tennessee
615/637-4353 | Scrap Iron, Aluminum, Copper,
Brass, Lead, Radiators |
| 45. Modern Scrap Metal
Route 17, Hwy. 62
Knoxville, Tennessee
615/584-1482 | Scrap Metals and Autos |
| 46. Rockwood Iron & Metal
McPerson Avenue, N.W.
Knoxville, Tennessee
615/546-7454 | Scrap Metals |
| 47. Southern Foundry Supply, Inc.
2826 Central N.
Knoxville, Tennessee
615/524-2791 | Scrap Metals Except Wire Steel,
Railroad Steel & Gas Tanks |
| 48. David Witherspoon, Inc.
901 Old Maryville Pike, SW
Knoxville, Tennessee
615/577-1613 | Aluminum, Brass, Copper, Steel,
Batteries, Lead, Radiators |
| 49. Automated Industrial Disposal & Salvage Co.
Bristol, Tennessee
(Ask operator for) WX 4183 or
615/764-4183 | Scrap Metals - Deals only with
bulk scrap metal in excess of
30,000 lbs. |
| 50. A. R. Briggs & Sons Car Crushing
Packinghouse Road
Kingsport, Tennessee
615/288-5391 | Scrap Iron & Metal & Junk Cars |
| 51. Elizabethton Herb and Metal Company
808 Lynn Avenue
Elizabethton, Tennessee
615/543-1991 | Iron, Metal |
| 52. Kingsport Iron and Metal Company, Inc.
Riverport Road
Kingsport, Tennessee
615/245-5124 | Cast Iron, Scrap Steel, Auto
Batteries, Radiators, Cooper,
Brass, Aluminum, Stainless
Steel |

- | | | |
|-----|---|---|
| 53. | Eubank's Auto Salvage
227 1/2 Old Pinson Road
Jackson, Tennessee
901/427-9569 | Scrap Metals |
| 54. | H. O. Forgy and Sons, Inc.
E. Parkway
Jackson, Tennessee
901/423-2195 | Scrap Metals |
| 55. | Jackson Scrap Materials Company, Inc.
Meadow
Jackson, Tennessee
901/427-5281 | Scrap Metals |
| 56. | Clark Iron and Metal Company, Inc.
217 Hillard
Murfreesboro, Tennessee
615/ | Scrap Metals |
| 57. | Cookeville Iron & Metal Company
Cookeville, Tennessee
615/ | Scrap Iron and Metal, Industrial
Scrap Auto, Farm Scrap, Copper,
Radiators, Brass and Batteries |
| 58. | Union City Iron and Metal Company
215 N. Depot
Union City, Tennessee
901/885-3161 | Scrap Metals |
| 59. | Hutcheson Scrap Metal
510 W. Walnut Avenue
McKenzie, Tennessee
901/352-3166 | Industrial Scrap, Stainless, Batteries,
Radiators, Brass, Iron, Copper,
Aluminum |
| 60. | Wilson Radiator Shop
622 N. Highland Drive
McKenzie, Tennessee
901/352-5905 | Scrap Metal |
| 61. | Lattus Distributing Company
Woodland Mills
Union City, Tennessee
901/885-0812 | Aluminum cans only |
| 62. | Union City Iron & Metal Company
215 N. Depot Street
Union City, Tennessee
901/885-3161 | Scrap Automobiles, Scrap Iron
and Metals, New and Used
Steel |
| 63. | Clinton Auto Parts
Knoxville Highway
Clinton, Tennessee
615/457-1636 | Iron, Farm Scrap, Metals, Copper,
Brass, Aluminum, Batteries,
New and Used Steel & Radiators |

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|-----|---|---|
| 64. | Copeland Refrigeration Sales & Service
819 Memorial Drive
Paris, Tennessee
901/642-1481 | Scrap Metal |
| 65. | Isbell's Scrap Iron and Coal Yard
Old Cowan Road
Winchester, Tennessee
615/967-2120 | Scrap Metals |
| 66. | Pitts Scrap Iron and Metal Company
15 Mill Avenue
Cookeville, Tennessee
615/526-2315 | Scrap Metals |
| 67. | Bedford Iron and Metal Company
Nashville Dirt Road
Shelbyville, Tennessee
615/684-4560 | Scrap Metals |
| 68. | Smith Metals
Railroad S
Selmer, Tennessee | Copper, Brass, Aluminum,
Stainless Steel Scrap, Batteries,
Radiators and Industrial Scrap |
| 69. | R. L. Smith Company
Cemetery Road
Selmer, Tennessee
901/645-6330 | Scrap Metals |
| 70. | Sanford & Sons Recycled Materials
28 Monroe Avenue
Brownsville, Tennessee
901/772-3262 or 901/772-0237 | All types of Scrap Metals |
| 71. | Lane Auto Salvage
Grimsley
Byrdstown, Tennessee
615/863-3161 | Scrap Auto Parts |
| 72. | Lui Heimansohn
50 Franklin
Clarksville, Tennessee
615/648-0851 | Scrap Metals, Iron, |
| 73. | Erwin Salvage, Inc.
Jonesboro Road
Erwin, Tennessee
615/743-3107 | Scrap Metals |
| 74. | Hi-Way 50 Junk Yard
1236 East Commerce
Lewisburg, Tennessee
615/359-2163 or 615/359-4558 | Copper, Brass, Aluminum,
Radiators, Starters, Generators,
Batteries |

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| 75. | Hill's Scrap and Salvage, Inc.
Route 8
McMinnville, Tennessee
615/668-4574 or 615/668-4385 | All Types of Scrap Metal and
Junk Cars |
| 76. | King's Auto Salvage
Route #1
McMinnville, Tennessee
615/668-9227 | Scrap Autos |
| 77. | Southern Central Iron and Metal
Route #3
McMinnville, Tennessee
615/668-8044 | Iron and Metals, Industrial
Scrap, Junk Cars, and Used
Auto Parts |
| 78. | Turner Auto Salvage
Route #1
McMinnville, Tennessee
615/668-4157 | Scrap Autos |
| 79. | Hutcherson Scrap Company, Inc.
South Mill
Halls, Tennessee
901/836-9435 | Scrap Iron, Metals, Batteries |
| 80. | Holston Surplus Metals
P.O. 649
Rogersville, Tennessee 37857
272-2614 | Scrap Iron, Metals, Batteries |
| 81. | Consolidated Aluminum Corp.
P.O. Box 150
Waverly, Tn. 37185 | Scrap Aluminum |

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HEAT RECOVERY

Facility

Capabilities

1. Nashville Thermal Transfer Corporation
Robert Buckman
110 1st Avenue, South
Nashville, Tennessee
615/255-1460

WASTE OILS AND SOLVENTS

<u>Facility</u>	<u>Capabilities</u>
1. Petroleum Recycling Corporation P.O. Box 10713 Knoxville, Tennessee 37919 615/693-7627	Oil reprocess and oil spill clean-up operators, oil waste; Will not handle oils which are contaminated with highly toxic chemicals
2. Ferguson Harbor Service 133 Cumberland Shores Drove Hendersonville, Tennessee 615/227-3395	Spill Clean-up
3. Systems Technology Corporation 1640 Antioch Pike Nashville, Tennessee 615/833-2059	Water/oil emulsions, cutting fluids, washer compounds, other oily waste and plating waste
4. Tennessee Oil & Refining Company Hwy. 109 Portland, Tennessee 615/242-3834	Fuel and Lubricant Recycling
5. John P. Saad & Sons, Inc. 3655 Trousdale Drive Nashville, Tennessee 615/834-2050 or 615/833-4977	Hauler
6. Oil Service Company Route #3 Columbia, Tennessee 38401 381-4999	Hauler
7. Gene A. Holmes, Inc. Millington Memphis, Tennessee 901/876-5252	Industrial Waste
8. Three Flags Chemical Disposal Company 901 Bradley Avenue Memphis, Tennessee 901/774-2340	Organic liquid elimination
9. United Oil and Chemical, Inc. 1015 Southern Road Memphis, Tennessee 901/521-0810	Solvent reclaimer and waste oil
10. PNB Corporation 8 3rd Street, North Memphis, Tennessee 901/526-2945	

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| 11. | Delta Refining Company
543 Mallory Avenue, West
Memphis, Tennessee
901/774-3100 | Oil Refiners |
| 12. | Murphey Oil Corporation Regional Office
5865 Ridgeway Parkway
Memphis, Tennessee
901/761-2810 | Oil Refining |
| 13. | Leaman Chemical Tank Lines
Holly Grove Road
Covington, Tennessee
901/476-8149 | Chemical Haulers |
| 14. | Necessary Oil Company
497 Island Road
*Bristol, Virginia 24201
703/669-4831 | Waste Oil Pickup |

*Process Plant located in Bristol, Tennessee
Office located in Bristol, Virginia

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INDUSTRIAL WASTE INCINERATORS

<u>Facility</u>	<u>Capabilities</u>
1. Environmental Systems 3299 Tulane Road Memphis, Tennessee 38116	Flammable liquid, liquid containing heavy metals are excluded
2. Solid Waste Disposal Smith Lane Dyersburg, Tennessee 38024 901/285-8481	Coolants, Cutting Oils, Waste Motor Oils, Lubricants and Transmission Fluids

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BARRELS AND DRUMS

<u>Facility</u>	<u>Capabilities</u>
1. Dixie Drum Service 1715 Pecan Franklin, Tennessee 615/242-9661	Used barrels and drums
2. B. J. Fox and Sons 337 2nd Avenue North 615/256-3512	Used barrels and drums
3. Airways Iron and Metal Company 2103 East Pearson Avenue Memphis, Tennessee 901/276-6346	Drums
4. Grief Brothers Corporation 1735 Florida Memphis, Tennessee 901/946-6076	Waste barrels and drums
5. JEHL Cooperage Company 4 Virginia Avenue East Memphis, Tennessee 901/775-3500	Used barrels and drums
6. Memphis Container Company 1761 Warford Memphis, Tennessee 901/452-7483	Used barrels and drums
7. Memphis Drum Service, Inc. 3299 Tulane Road Memphis, Tennessee 901/396-6484	Used barrels and drums
8. Joseph E. Seagrams & Sons, Inc. 155 Wisconsin Avenue Memphis, Tennessee 901/947-4121	Used barrels and drums
9. Sirco Systems, Inc. 705 Royal Memphis, Tennessee 901/525-1767	Used barrels and drums
10. Tennessee Container Corporation 700 N. Second Memphis, Tennessee 901/526-2503	Used barrels and drums

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| 11. | J and L Drum Company
256 South Parkway E.
Memphis, Tennessee
901/942-0802 | |
| 12. | Cole Steel Drum, Inc.
1635 Lakeview Drive
Rossville, Tennessee
615/866-3051 | Used drums |
| 13. | Tri-STATE Steel Drum Company, Inc.
Graysville, Tennessee
615/891-9726 | Used drums |
| 14. | A-1 Wiping Rag Company
1721 Western Avenue, NW
Knoxville, Tennessee
615/525-5355 | Barrels and Drums |
| 15. | Dixie Barrel and Drum Company, Inc.
2120 Jones, SE
Knoxville, Tennessee
615/573-8989 | Used barrels and drums |

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INDUSTRIAL WASTE BROKERS

<u>Facility</u>	<u>Capabilities</u>
1. Earth Industrial Waste Management, Inc. 1 Commerce Square Suite 1570 Memphis, Tennessee 38103 901/521-0096	Takes title to and arranges reclamation or disposal of industrial wastes, consulting services available